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DEVOTED TO THE CONVERSION, TRANSMISSION and DISTRIBUTION OF ENERGY.

VOL. XIII.—No. 10 SAN FRANCISCO, CAL., OCTOBER, 1903. YEARLY SUBSCRIPTION - $2.00 SINGLE COPIES - 25 CENTS

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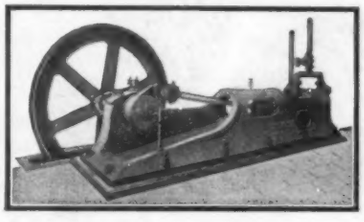

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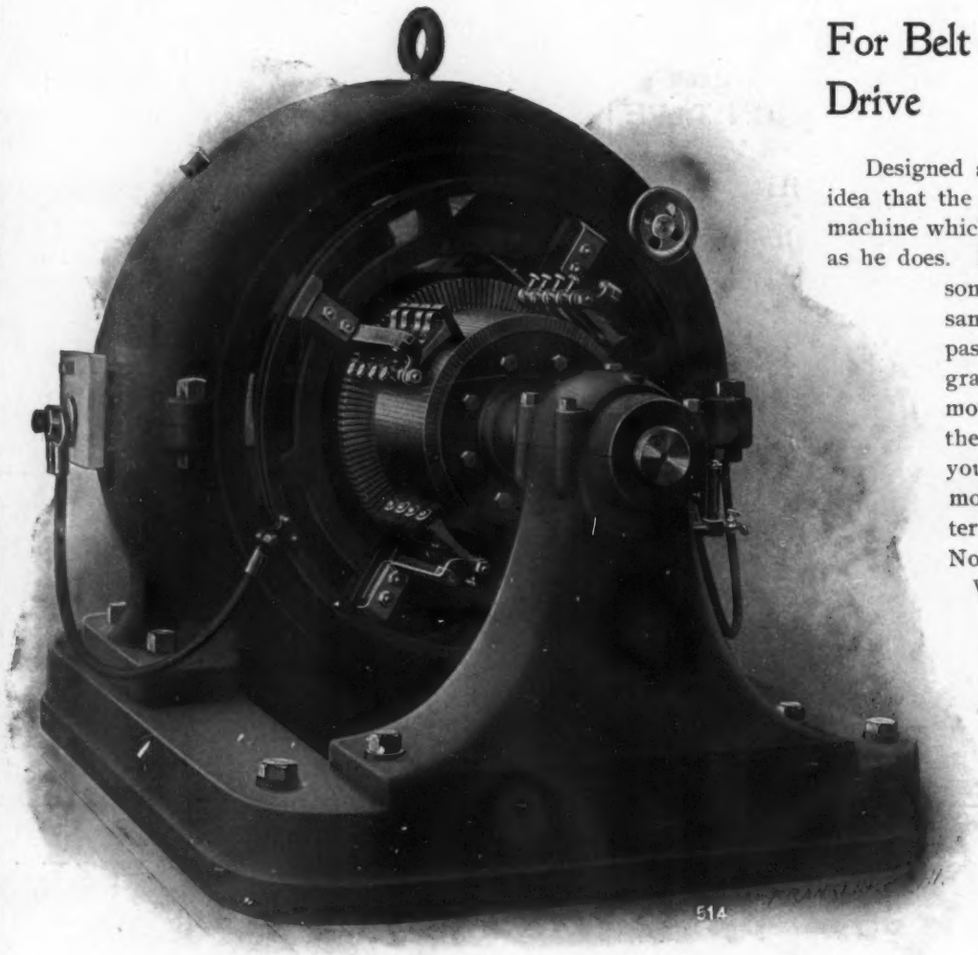
Northern Electrical Manufacturing Company

MADISON, WIS.

NORTHERN GENERATORS are RUGGED and SUBSTANTIAL but Clean Cut and Symmetrical



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Designed and built with the idea that the purchaser wants a machine which will live as long as he does. In truth, we think some of these self-same machines will be passed on to sons and grandsons. Northern motors are built on the same principle. If you would like a little more light on the matter write for Bulletin No. 926.

We have made some of the largest installations for complete electric drives in America, and challenge a comparison of economical working.

We build all sizes of generators and motors for either alternating or direct current.

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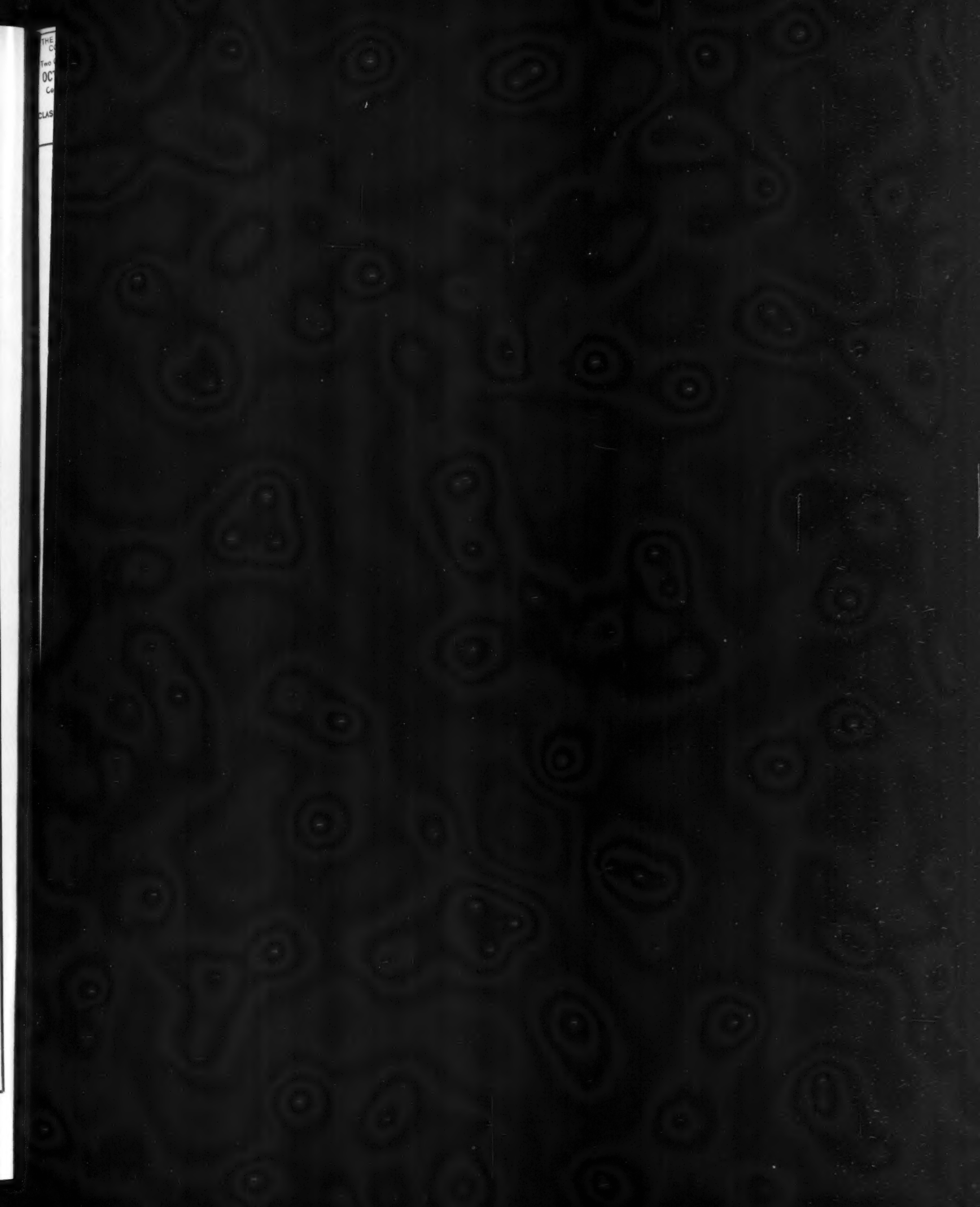

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The Journal of Electricity, Power and Gas.

Devoted to the Conversion, Transmission and Distribution of Energy.

VOLUME XIII. SAN FRANCISCO, CAL., OCTOBER, 1903. NUMBER 10

Proceedings of the Eleventh Annual Meeting of the Pacific Coast Gas Association.

Papers and Discussions.

The Eleventh Annual Meeting of the Pacific Coast Gas Association was called to order by President M. C. Osborn at 10:40 a. m., Tuesday, July 21, 1903.

On motion of Mr. Britton the formal roll call and also the reading of the minutes of the session of 1902 were dispensed with.

The report of the secretary and treasurer was then read, and on motion of Mr. Britton unanimously adopted.

REPORT OF SECRETARY-TREASURER.

SAN FRANCISCO, July 21, 1903.

To the President and Directors of the Pacific Coast Gas Association:

GENTLEMEN—I submit herewith report of my office for the year ending July 1, 1903.

FINANCIAL.

Balance on hand July 1, 1902 (as per last report dated July 15, 1902)		$258.70
RECEIPTS.		
Dues	$555.00	
Initiations	70.00	
Contributions, General Fund	666.40	
Contributions, Library Fund	250.00	
Sale of Association Pins	12.50	$1,553.90
Total		$1,812.60
DISBURSEMENTS.		
As per Vouchers Nos. 1 to 43 herewith		$1,011.20
Balance cash on hand July 1, 1903		$801.40

LIST OF VOUCHERS.

1.	Charles S. Wheeler, caterer	$101.00
2.	Noah Brandt, music	38.50
3.	Noah Brandt, music	27.50
4.	H. S. Crocker, cards	15.10
5.	Walter Brunt, printing	16.00
6.	M. A. Gunst, cigars, etc	34 00
7.	Monticello Steamship Company, rent steamer, etc.	159.80
8.	J. Malfanti & Co., banquet	224.50
9.	Walter N. Brunt, printing	7.75
10.	The Whitehead & Hoag Co., badges	13.20
11.	Union and Herald Printing Office	14.00
12.	Armstrong & De Guerre, cuts	2.40
13.	Telegraph Publishing Company, printing	2.00
14.	Stephen Potter, stenographer	159 90
15.	Philadelphia Book Company	3.60
16.	Philadelphia Book Company	27.90
17.	Philadelphia Book Company	12.15
18.	Armstrong & De Guerre, stationery for Library Committee	6.25
19.	Moise-Klinkner, rubber stamps	2.50
20.	J. B. Grimwood, telephone, telegraph and incidentals	15.65
21.	Walter N. Brunt, stamped envelopes	12.25
22.	Walter N. Brunt, printing	9.00
23.	Geo. S. Colquhoun, expenses "Wrinkle Department," 1902	8.45
24.	R. P. Valentine, expenses "Experience Department"	6.25
25.	The West Coast Typewriting Company, letters, etc.	2 50
26.	Schussler Bros., picture frames	2.15
27.	Wells, Fargo & Co. Express, cuts from *American Gas Light Journal*	2.15
28.	Philadelphia Book Company	4.15
29.	Philadelphia Book Company	3.20
30.	Yawman & Erbe, card indices	1.90
31.	Philadelphia Book Company	7.20
32.	Philadelphia Book Company	3.50
33.	Philadelphia Book Company	3.40
34.	Commercial Publishing Company, library catalogue	16.00
35.	E. R. Waite (National Oil Men's Association), book	5.00
36.	The West Coast Typewriting Company, letters, etc.	10.20
37.	Armstrong & De Guerre, letter heads	2.70
38.	Armstrong & De Guerre, binding books	9.40
39.	Philadelphia Book Company	1.40
40.	J. B. Grimwood, stamps	5.00
41.	M. M. Crooks, stenographer	2.50
42.	Yawman & Erbe, card indices	1.20
43.	J. B. Grimwood, sundry expenses	8.00

The total disbursements for the past year as given above may be seggregated as follows:

Preparation for meeting, stenographer's fees and current expenses	$224.80
Banquet	328.10
Outing	288.30
Library expenses	108.75
General expenses	61.25
Total	$1,011.20

ANNUAL STATEMENT LIBRARY FUND, 1902–1903.

Balance on hand as per report of July, 1902		$81.10
RECEIPTS.		
July 15, 1902, American Stove Company	$100.00	
September 23, 1902, G. S. Colquhoun	25 00	
April 3, 1903, Spokane Falls Gas Light Company	25.00	
June 11, 1903, W. F. Boardman Company	100.00	250.00
Total		$331.10
EXPENDITURES.		
September 10, 1902, Philadelphia Book Company	3.60	
September 10, 1902, Philadelphia Book Company	27.90	
September 10, 1902, Philadelphia Book Company	12.15	

October 10, 1902, Armstrong & De Guerre, stationery	6.25	
October 10, 1902, Moise-Klinkner, rubber stamps	2.50	
February 4, 1903, Philadelphia Book Company	4.15	
February 24, 1903, Philadelphia Book Company	3.20	
March 6, 1903, Yawman & Erbe, card indices.	1.90	
Marah 21, 1903, Philadelphia Book Company.	7.20	
March 30, 1903, Philadelphia Book Company.	3.50	
April 7, 1903, Philadelphia Book Company	3.40	
April 15, 1903, Commercial Publishing Company, catalogues	16.00	
May 6, 1903, E. R. Waite, book on Oil B. F.	5.00	
June 2, 1903, Armstrong & De Guerre, binding books.	9.40	
June 11, 1903, Philadelphia Book Company	1.40	
June 29, Yawman & Erbe, card indices	1.20	108.75
Balance on hand July 1, 1903		$222.35

BADGES OR PINS.

On hand July 1, 1902	5
Sold during year	5
On hand July 1, 1903	none

MEMBERSHIP.

As of July 1, 1902	120	
Elected Tenth Annual Meeting, July 15, 1902	19	139
Year ending July 1, 1903:		
Suspended	none	
Resigned	6	
Died	1	
Failed to qualify	1	
Total	8	
Reinstated	2	6
Total membership July 1, 1903		133
Total membership July 1, 1902		120
Gain in membership		13

THE FOLLOWING HAVE APPLIED FOR MEMBERSHIP.

REGULAR MEMBERSHIP.

1. Philo Jones, superintendent, Salinas Water, Light and Power Company, Salinas, Cal.

2. Henry L. Doherty, engineer, Denver Gas and Electric Company, Denver, Col.

3. J. W. Morton, Dunham, Carrigan & Hayden Company, San Francisco, Cal.

4. F. A. Leach, Jr., accountant, Oakland Gas, Light and Heat Company, Oakland, Cal.

5. Robert J. Thompson, Welsbach Company, San Francisco, Cal.

6. A. J. P. Matthiesen, Welsbach Company, San Francisco, Cal.

7. John Klepper, superintendent, Phœnix Gas Company, Phœnix, Arizona.

8. Thomas W. Brooks, National Tube Company, San Francisco, Cal.

9. Franklin Riffle, Dunham, Carrigan and Hayden, San Francisco, Cal.

10. R. N. Adams, Secretary Los Angeles Lighting Company, Los Angeles, Cal.

11. Roderick McKay, superintendent of manufacture, Los Angeles Lighting Company, Los Angeles, Cal.

12. H. M. Corlette, assistant manager, Los Angeles Lighting Company, Los Angeles, Cal.

13. W. J. Dorr, superintendent of distribution, Los Angeles Lighting Company, Los Angeles, Cal.

14. Herman Weber, manager Petaluma Gas and Electric Company, Petaluma, Cal.

15. Fred A. Rasch, Portland Gas Company, Portland, Oregon.

16. A. Ross, Independent Gas and Power Company, San Francisco.

17. W. E. Osborn, Woodland Gas and Electric Company, Woodland, Cal.

18. C. W. Conlisk, secretary, California Gas and Electric Corporation, San Francisco, Cal.

19. J. E. Poingdestre, manager, Grass Valley Division Nevada County, Gas and Electric Company, Grass Valley, Cal.

ASSOCIATE MEMBERSHIP.

1. United Gas and Electric Company, San Jose, Cal., no representation named, 1.

2. Suburban Electric Light Company, San Leandro, Cal., no representation, 1.

3. The Walla Walla Gas and Electric Company, Walla Walla, Wash., no representation, 1.

4. Spokane Gas Company, Spokane, Wash., I. W. Anderson, vice-president, 4.

5. Stockton Gas and Electric Company, Stockton, Cal., no representation, 1.

6. Chico Gas and Electric Company, Chico, Cal., J. L. Hoke, representative, 1.

7. Colusa Gas and Electric Company, J. D. Kuster, representative, 1.

8. Grass Valley Division, Nevada County Gas and Electric Company, J. E. Poingdestre, representative, 1.

9. Nevada City Division, Nevada County Gas and Electric Company, John Werry, representative, 1.

10. Petaluma Gas and Electric Company, Herman Weber, representative, 1.

11. San Rafael Gas and Electric Light Company, F. E. Fitzpatrick, representative 1.

12. Woodland Gas and Electric Company, W. E. Osborn, representative, 1.

13. San Luis Gas Company, San Luis Obispo, Cal., E. S. Hoyt, Robert N. Frick, 2.

14. San Francisco Gas and Electric Company, San Francisco, Cal. S. Russell, Thomas Finn, Charles L. Barrett, Allan Pollak.

15. Whatcom County Railway and Light Company, Whatcom, Wash., no representative named, 1.

Respectfully submitted,

J. B. GRIMWOOD, Secretary.

The report of the directors was then read by the secretary, and on motion of Mr. Lowe was unanimously adopted.

REPORT OF THE BOARD OF DIRECTORS.

To the Members of the Pacific Coast Gas Association:

We, the undersigned Directors of the Pacific Coast Gas Association for the year 1902-1903, beg leave to report that we have examined the books and vouchers of the Secretary and Treasurer for the above mentioned year, and approve the same as correct. Proper vouchers are on hand for all disbursements and receipts have been properly posted, the balance of cash on hand as of July 1, 1903, being eight hundred and one dollars and forty cents ($801.40).

The following papers have been submitted, which we approve and hereby authorize for presentation at this, our Eleventh Annual Meeting:

President's Address, Mr. M. C. Osborn, San Francisco, Cal.

"Liquid Air. Its Application to the Gas Industry," Prof. G. A. Bobrick, Los Angeles, Cal.

"High Pressure Gas Distribution," Mr. John A. Britton, Oakland, Cal.

"Our Customers and their Complaints," Mr. D. Decker, Santa Rosa, Cal.

"The Oil Industry of California from a Commercial Standpoint," Dr. C. T. Deane, San Francisco, Cal.

"Wrought Iron," Mr. Franklin Riffle, San Francisco, Cal.

"Practical Protection of Metal Surfaces in Gas Plants," Mr. L. P. Lowe, San Francisco, Cal.

"Peak Loads in the Gas Business" (a short topic) Mr. J. B. Grimwood, San Francisco, Cal.

We recommend the following for election to membership in the Pacific Coast Gas Association;

ASSOCIATE MEMBERSHIP.

1. United Gas and Electric Company, San Jose, Cal., no representative named, 1.
2. Suburban Electric Light Company, San Leandro, Cal., no representative named, 1.
3. The Walla Walla Gas and Electric Company, Walla Walla, Wash., no representative named, 1.
4. Spokane Gas Company, Spokane, Wash., I. W. Anderson, Vice-President, 4.
5. Stockton Gas and Electric Company, Stockton, Cal., no representative named, 1.
6. Chico Gas and Electric Company, Chico, Cal., J. L. Hoke, representative, 1.
7. Colusa Gas and Electric Company, Colusa, Cal., J. D. Kuster, representative, 1.
8. Grass Valley Division, Nevada County Gas and Electric Company, J. E. Poingdestre, representative, 1.
9. Nevada City Division, Nevada County Gas and Electric Company, John Werry, representative, 1.
10. Petaluma Gas and Electric Company, Herman Weber, representative 1.
11. San Rafael Gas and Electric Light Company, F. E. Fitzpatrick, representative, 1.
12. Woodland Gas and Electric Company, W. E. Osborn, representative, 1.
13. San Louis Gas Company, San Louis Obispo, Cal., E. S. Hoyt, representative, Robert N. Frick, representative, 2.
14. San Francisco Gas and Electric Company, San Francisco, Cal., S. Russell, Thomas Finn, Charles L. Barrett, Allan Pollak, 4.
15. Whatcom County Railway and Light Company, no representative named, 1.

REGULAR MEMBERSHIP.

1. Philo Jones, superintendent Salinas Water, Light and Power Company, Salinas, Cal.
2. Henry L. Doherty, engineer, Denver Gas and Electric Company, Denver, Colorado.
3. J. W. Morton, Dunham, Carrigan and Hayden Company, San Francisco, Cal.
4. F. A. Leach, Jr. accountant, Oakland Gas Light and Heat Company, Oakland, Cal.
5. Robert J. Thompson, Welsbach Company, San Francisco, Cal.
6. A. J. P. Matthiesen, Welsbach Company, San Francisco, Cal.
7. John Klepper, superintendent, Phoenix Gas Company, Phoenix, Arizona.
8. Thomas W. Brooks, National Tube Company, San Francisco, Cal.
9. Franklin Riffle, Dunham, Carrigan and Hayden Company, San Francisco, Cal.
10. R. M. Adams, secretary, Los Angeles Lighting Company, Los Angeles, Cal.
11. Roderick McKay, superintendent of manufacture, Los Angeles, Cal.
12. H. M. Corlette, assistant general manager, Los Angeles Lighting Company, Los Angeles, Cal.
13. W. J. Dorr, superintendent distributing department, Los Angeles Lighting Company, Los Angeles, Cal.
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18. C. W. Conlisk, secretary, California Gas and Electric Corporation, San Francisco, Cal.
19. J. E. Poingdestre, manager, Grass Valley Division, Nevada County Gas and Electric Company, Grass Valley, Cal.

(Signed) JOHN A. BRITTON,
R. P. VALENTINE,
W. A. ALDRICH,
C. O. G. MILLER,
M. C. OSBORN.

The report of the library committee was then read by the secretary (in the absence of E. C. Jones, its chairman), and on motion of Mr. Britton was ordered received and placed on file.

REPORT OF LIBRARY COMMITTEE.

The President and the Members of the Pacific Coast Gas Association:

Your Library Committee begs to report as follows: The work of your committee during the past year has been in the nature of missionary work to get money to provide books and to urge our members to read them. In both, when compared with the work of the library committees of other associations, we feel encouraged, because there have been frequent calls for books and inquiries for reference on special subjects during the year which tend to show that the library fills a need.

It is not necessary to report the number of books taken from the library, but it suffices to say that the library has been generously used during the past year, and that as it increases in value it will be more used. During the year it was found necessary to issue a complete catalogue of books, a copy of which is attached, and which it is hoped affords the members an opportunity to avail themselves of the valuable information contained in our collection of books.

Following is a statement of the receipts and disbursements for the past year.

STATEMENT OF LIBRARY FUND, JULY 1, 1903.

RECEIPTS.

Balance on hand March 1, 1903, as per report of March 4, 1903	$146.35	
April 3, 1903, Spokane Falls Gas Light Company	25.00	
June 11, 1903, The W. F. Boardman Company	100.00	$271.35

DISBURSEMENTS

March 6, 1903, Yawman & Erbe Manufacturing Company	$ 1.90	
March 21, 1903, Philadephia Book Company	7.20	
March 30, 1903, Philadelphia Book Company	3.50	
April 7, 1903, Philadelphia Book Company	3.40	
April 15, 1903, Commercial Publishing Company	16.00	
May 6, 1903, E. R. Waite, National Oilmen's Association	5.00	
June 2, 1903, Armstrong & De Guerre	9.40	
June 11, 1903, Philadelphia Book Company	1.40	
June 29, 1903, Yawman & Erbe Manufacturing Company	1.20	$ 49.00
Balance on hand July 1, 1903		$222.35

A short time ago Mr. W. F. Boardman, representing the Schneider and Trenkamp Company, the Standard Lighting Company, the General Gas Lighting Company and Messrs. Lindsay and Company, donated One Hundred Dollars (being $25.00 from each of the four concerns named) for the purchase of books to be presented to the library, and it was the express wish of Mr. Boardman that the chairman of the Library Committee should purchase certain books on the subjects of petroleum, gas engines, steam engineering, and engineer's handbooks, amounting to the above sum. These books have been carefully selected and are now on their way from the East, and it is hoped they will arrive

before the Annual Meeting of the Association, in order that they may become a part of the library and be open for the inspection of our members. We now have a creditable collection of books, and it is hoped that the members will avail themselves of the opportunity to use these books freely.

To the contributors above noted is due the thanks of the Association and its individual members for this generous contribution.

Your committee wish to call your attention to the fact that the formation of several libraries in connection with the various gas associations in this country and abroad, have caused a demand for books which were considered obsolete and almost valueless, and hence has brought them into demand, that it becomes necessary for us to procure these books for our library as soon as possible while they may be procured at reasonable prices. The committee therefore urges the members of the Association to contribute as liberally as possible to the Library Fund, in order that the plans of the committee may be carried out, and that our library may be worthy of our Association. It should also be understood that any money spent on books pertaining to our business is an excellent investment, as most of the books are becoming rare and are increasing in value.

The Association is indebted to Mr. J. B. Grimwood for the design and contribution of a book plate, which is an artistic reminder to all of us that the books should be promptly returned to the bookcase of the Association after they have been used.

Your committee is glad to say that the library and the library funds are in good condition and to express a feeling of satisfaction in having performed a work during the past year which has been productive of some good and much appreciation.

Respectfully submitted,

(Signed) E. C. JONES, Chairman
GEO. C. HOLBERTON
L. P. LOWE

THE PRESIDENT. The next business before the Association is the election of new members.

MR. BRITTON. I take it that as the board of directors in its report has already recommended the election of these members, they are now virtually elected, and no other action of the Association is necessary, unless there should be some objection to some one of the members, or to any or all of them, and the Association should desire to elect individually.

MR. LOWE. I move that the secretary cast the ballot of the Association announcing the election to active membership of those proposed in the report of the directors.

[Carried, and so ordered.]

THE PRESIDENT. Next on our programme comes the reading of the President's Address. Will the vice-president kindly take the chair?

PRESIDENT'S ADDRESS.

BY M. C. OSBORN

Members of the Pacific Coast Gas Association:

GENTLEMEN: Another year has elapsed since we were assembled to discuss the conditions confronting our business and exchange our experiences for the year.

Our Association, taking in the states of California, Nevada, Oregon, Washington, Arizona and Utah, and including British Columbia, no doubt has more natural resources for the production of artificial light in its many forms than any of our sister states embraced by the several gas associations east of the Rocky Mountains. Bordering on the north we have our vast coal deposits, with water power in abundance, while in the east we have our coal, in the west and south we have a natural storage of oil easy of access, the extent of which is beyond the calculation of man, with the ever-flowing streams of our mountains to furnish light and power. Taking into consideration the few years the Pacific Coast has been inhabited by civilized man, there can be no doubt but what these resources are as well if not better developed than those of the states east of the Rocky Mountains or of Europe.

The climatic conditions enjoyed by the Pacific Coast states make the introduction of light and power to the centers of population comparatively easy with reference to the conditions in our sister states, so that it is not to be wondered at that in some of our operations we challenge the world.

Since our last meeting vast combinations in the lighting industry have taken place which affect the personal, mechanical, commercial and social relations of the companies and members embraced in this Association.

Before entering upon the discussion of the subjects of most interest, it becomes my sad duty to inform you of the death of one of our members, C. E. Burrows Jr., who was accidentally drowned in Puget Sound on August 9, 1902. The death of Brother Burrows is particularly sad, coming as it did during a promised vacation after the return of C. E. Burrows Sr. from the last meeting of this Association as its president. Very little is known as to the actual cause of the accident. It happened on a pleasure yacht in Puget Sound. All had retired to their staterooms for the night in the best of spirits. In the morning Mr. Burrows was not to be found. Fortunately the body was recovered the same day, with a cut over the right eye. It is supposed that he fell overboard. His last words to his host were, "This is the best week I have ever spent in my life." While Mr. Burrows had never attended a meeting of the Association, he has been identified with the lighting business all his life, and it was his intention to attend this meeting and associate with its members as his honored father has. It was the intention of Mr. Burrows Sr. to soon retire from the active management of the Walla Walla Lighting Company and install his son as a worthy successor. Brother Burrows was 31 years of age, and leaves a father, wife, son, brothers and sisters to mourn his loss. It will be the duty of the Association to pass suitable resolutions expressing our sympathy and condolence to the bereaved relatives.

Perhaps the most startling discovery made in the scientific world affecting the lighting industry is a new metal called "radium," which is manufactured from a radis-active mineral called pitchblende. It requires 5000 tons for one pound of radium, and is practically indestructible. It is reported to give light, heat and power, but it is still in its experimental stage, so that nothing is known of its practicability. It is possible, however, that the energy we are collecting from our mountains and the gas from our coal and oil will yet be a factor in the reduction of this wonderful mineral.

It has been said that the receipts of a lighting company are a better barometer of the times than any other business. The lighting business, like all other industries, has enjoyed a year of unparalleled prosperity. This is so much the case that enlarged capital has entered the field, in some places rates being increased, in others reduced, the service improved and capital guaranteed a fair return on its investment, so that it can safely be said that the lighting question on the Pacific Coast is now on a more satisfactory basis both from the point of view of the owner and consumer than ever before in its history.

The social relations formed by the meetings of this Association have assisted in this encouragement of capital so that the men at the helm and the men of capital are more closely united than ever before. The men who organized this Association were at the time of the organization hampered by a lack of concentrated effort. The association of capital has brought them together so that there is a unity of action, with all working for the one common purpose of manufacturing and selling our commodity at the lowest price consistent with its cost, and which cost has been materially reduced by reason of this association of capital. To verify the foregoing, I wish to call to your attention the facts gathered in answer to my circular letter of last April. The record is not so complete as I would like it, only twenty-six companies having responded. These reports show that the first works were built in 1858 and the last in 1902. The highest price per thousand at date of erection was $10; the lowest, 52 cents per thousand. The average for the twenty-six companies being $5.16 per thousand. The highest price today is $3.00 per thousand and the lowest 52

cents, the average being $1.52 per thousand. Two other factors, however, enter into the development of our industry, namely, competition and oil. The advent of electricity, generated as it was from central stations, proved to be an educator to managers of gas companies, so that when the energies generated in our mountains were transmitted by conductors to our doors we were prepared to treat them as a friend rather than a competitor. The result is that today gas and electricity go hand in hand, and we are no longer gas engineers and gas men, but, as Past President Britton remarked in his address two years ago, we are now engineers of lighting and men in the lighting business. For reasons known to us all, electricity is fast gaining the ascendency for lighting purposes, so that the men in the lighting business are devising new avenues for the sale of gas in the shape of fuel and power. Such enormous strides in this direction have been taken that it is safe to say that more gas is being sold today than would have been had electricity not become practicable for lighting purposes. The competition of solid fuel against fuel gas has brought out more engineering skill and business energy from members of our fraternity than any event in the history of lighting and fuel on this coast.

Improved apparatus, reducing the cost of production; large extensions of our distributing systems, tending to increase our output; intelligent business management, presenting our commodity to the public in a proper manner, are a few of the many things that have brought the gas industry to the prosperous condition it occupies today.

The discovery of oil within easy reach is the other factor which has enabled us to successfully compete with solid fuels. It is useless for me at this time to dwell on the importance of this commodity. Its commercial and industrial value will be brought out later in the session.

Municipal ownership is still being agitated in some sections, and in this connection I will give some data coming from properties owing their existance to Gas and Electric Light Commissions and which have particular significance with reference to the agitation in favor of Gas and Electricity Light Commissions on this coast. The Gas and Electric Light Commission of the State of Massachusetts exercises the control of capitalization and the rates for gas and electricity in that State and governs the granting of franchises, guaranteeing existing companies returns on the capital invested. Public ownership controls three gas and fifteen electric plants. The average price of gas in these plants is 48 cents per thousand higher than the average price of gas on which I have reports on this coast. The average cost of electric street arc lighting is $75.60 on a moonlight schedule and for all night lighting $137.73 per lamp per year, while the charges for current range from 10 cents to 25 cents a kilowatt.

From reports received from the two gas plants operating under public ownership on this coast, I find that one charges 23 cents and the other 98 cents per thousand more than the average price of the private companies. With reference to one of these plants, its town is bonded for the purchase of the gas property, the same to be paid for by the profits from the sales of gas, thus compelling those who are in the minority, to wit, the gas consumers, to pay for the public utility, being an apt illustration of the defects in the theory of municipal ownership.

I wish to emphasize the words of Past-President Britton, who said two years ago, "There is one safe and sure remedy that can be applied to cities where it does not exist as a preventive and that is the placing of all corporations on a footing where criticism cannot be made of their methods of earning interest on the moneys invested." It is interesting to note that the policy is being carried out. Public ownership is still being agitated, when it is a fact well known that the prices at present charged by local companies are lower than the cost of production would be to the municipalities which are agitating public ownership.

The labor question has effected our industry in some sections as it has other industrial pursuits. In my judgment, the situation depends upon the old law of supply and demand. So long as the demand for labor remains greater than the supply, labor will demand and receive a hearing in turning the wheels of our industry.

Like my predecessors, I have to report that the pre-payment meter has not met with the favor on this coast it has received in the Eastern states and in Europe. This would indicate that this meter is more adapted to larger centers of population. As far as my personal observation goes I have in mind a plant which had a larger proportion of pre-payment meters in use than any other and the smallest consumption per meter than any other plant that has come under my notice.

The question as to what is considered good business policy in the introduction of gas-consuming appliances seems to have been settled by common consent, the custom being now general to install at cost.

The policy of having two meters, one for light and the other for fuel, is still a mooted question, and in my judgment will only be settled when we have reached that point in increased consumption when the cost of production will be so nearly alike that the difference will not pay for the additional installation.

All questions submitted to the Advisory Board have been promptly answered and it is to be hoped that it will be more generally consulted as time goes on. The Board was created by the Association for the purpose of lending assistance to all who might require it.

A question of great importance to my mind and one of deep interest to those who are brought in close contact with Association matters is the library. The Library Committee is to be commended for its energy and for its judgment displayed in the selection of some 180 volumes in addition to gas association reports, bound journals and matter of general interest to our Association. The collection has been made within the last two years and is made up entirely of donations. The publication of the library catalogue last March has stimulated interest in the library but it has not reached the point of usefulness to the members in general that it should attain, as there are no funds available. Various ideas have been advanced to promote this very important matter. The most feasible one seems to be the proposition of establishing headquarters for the Association with a librarian in charge. To promote this idea and assist our treasurer, you will be called upon to vote on an amendment to the Constitution and By-Laws to establish Association memberships. The condition of our treasury shows that as the membership now stands, all money received is absorbed to pay our fixed charges, leaving nothing for the library. It is doubtful if the plans thus far advanced will raise a sufficient amount to enable us to carry out our cherished idea.

At our Fifth Annual Meeting a resolution was introduced proposing to change our name and to form this body into a gas and electric light association. The resolution was promptly voted down. This was at a time when gas as an illuminant was being displaced by electricity. Gas as fuel was in its infancy. A majority of our members were gas men with electricity as a competing power and a certain amount of friction existed. Time has worked great changes in the personnel of this Association. As has been said, we are no longer gas engineers and gas men but engineers of lighting and men in the lighting business. Very few remain who are still competing with electricity but on the contrary nearly all are selling it. For several years back we have had papers read at our meetings dealing exclusively with our ancient enemy. We now have prices so adjusted that gas is a strong competitor in the lighting field and its use as a fuel is established beyond question. It has a future in the industries of the world both as a necessary commodity and as a money-maker. It may be said that if a change were made, the electrical interests would crowd the gas men out. The fight that we as gas men have put up for several years would tend to disprove this theory. We are all primarily gas men, and I believe that if we should change to a gas and electric association that the gas interests would receive all the prominence in our proceedings that its position in this industrial world and its relative commercial value with what might be termed its brother illuminant would deserve.

As an Association we would become broader and would expand our sphere of usefulness by the change, and would be another source of revenue.

I will not now consume your time by giving a resume of the papers prepared for this meeting except to say that they are all on live topics of interest to gas men, and as far as possible the wishes of the members in answer to my circular letter have been carried out in their preparation.

THE VICE-PRESIDENT. We have listened to a very interesting address from our president, and it becomes my pleasant duty to name as a committee on President's Address, L. P. Lowe, J. W. Thomas and Frank A. Cressey.

THE PRESIDENT. The next business on the programme is the amendment to the Constitution and By-Laws. Perhaps, without any preliminary discussion, it would be best to have the secretary read the amendments. The question will then be open for discussion.

The amemdment was then read by the secretary, as follows:

RESOLVED, That Article III of the Constitution be amended by inserting after Clause One, the following: Corporations, companies, firms or individuals engaged in the business of manufacture or sale of gas shall be eligible as Associate Members of the Association, and as such entitled to all the privileges of Active Membership, excepting that of voting or holding office.

RESOLVED, That Article V, Section I, of the By-Laws be amended to read as follows:

"The fees for Active Membership shall be five dollars, and the yearly dues shall be five dollars, payable annually thereafter."

For Associate Membership there shall be no fee, and the dues shall be five dollars per annum for each membership taken by each Associate Member, or representative. The number of representatives allowed to each Associate Member shall be limited to four.

THE PRESIDENT. You have heard the reading of this amendment. It is now open for discussion. As Mr. Britton introduced this resolution at our last meeting it will probably be best for him to explain to the Association its exact purpose.

MR. BRITTON. I think the matter was very fully covered at the last session, and all the reasons given why we should have an associate membership. I do not think it necessary to enlarge further upon the matter at this time, and I therefore move you that the resolution be adopted as read.

[Unanimously carried.]

I now move you that the secretary be instructed to cast the ballot of this Association for the applicants for associate membership as read in his report and adopted by the directors.

[Unanimously carried.]

THE PRESIDENT. Gentlemen, it is now within twenty-five minutes of our lunch hour. We have a little time on our hands. I do not think it would be well to start the reading of any of the papers and have them interrupted during the lunch hour. Are there any matters of interest that should come up?

THE SECRETARY. I would like to say a few words in regard to the "Question Box." Probably all of you are familiar with the work done by the Ohio Gas Light Association. They went into it, under the direction of Henry L. Doherty as editor, in an elaborate way. He sent notices to the members of the several gas associations in the United States whose addresses he could find, asking that questions be sent to him—questions of importance to the individual to whom the notices were sent. In response he received an overwhelming number of questions. He then undertook the task of assigning these questions—not exactly assigning them, but rather arranging them under various heads, such as manufacture, distribution, etc. Printed copies were sent to various gas men throughout the United States requesting them to answer as many questions as they could. After a number of months of hard work Mr. Doherty published a book (we have a copy in the library) giving these questions and the answers, and the names of the gas men throughout the country contributing answers. I do not think anyone appreciates the amount of work expended on this sort of thing, and I hardly think they realize the value it is to associations and gas men in general. I think that for a long time to come we shall feel the benefit of this publication. It occurred to me that we might do something of the same sort in our Association, but not on quite such an elaborate plan. We might confine ourselves to our own district—to the Pacific Coast. We might also depart from Mr. Doherty's plan in this respect: He received answers from various sources, many of them good sources; but many of them practically unknown. I find in looking over his publication a number of conflicting answers. A great many questions were answered "Yes" or "No." Others went into more detail and gave the reasons for the answers. In looking over the book I have found myself several times in this dilemma: A question was asked. One man answered it "Yes." Another man answered it in the same terse way "No." I find I am no nearer a solution of the difficulty. It occurred to me that we might send out requests to the members of our Association to ask questions of the Association—not to be sent out for answer to any individual member of the Association, but to be answered by the Association. By that I mean that the Association would, in so far as it is possible, be responsible—that there would be a certain moral responsibility for the answering of these questions. A man wants to know something; he has no facilities for looking the matter up, and he sends the question to the Pacific Coast Gas Association (not to any individual member whom the secretary may see fit to select); and the Association, through its officers, endeavors to get a correct answer for that question. Of course I realize that it is not always possible to do this. But we can, to a great measure, get good and reliable answers to the questions if the officers of the Association will take sufficient interest in it and will devote enough of their time to the matter to reply in proper form to the questions. That means that somebody will have to do a good deal of work. The best informed men must refer to authorities. But it occurred to me that where a question is sent in, someone who has the interest of the Association at heart could make it his business to look that matter up and make something in the nature of a short report, which could be read at the succeeding meeting of the Association; and I believe that if the proper interest is shown in the "Question Box," it may be made one of the most valuable features of our Association on these lines. I took it up this year and sent out postals asking the members to send in questions of great interest to them personally, and saying that the Association would answer them. The time was short, and I cannot say that I have met with the success which I had hoped for. We received, I think, in the neighborhood of fifteen questions. For some of these I have good reliable answers. For some I have not succeeded in getting any answers at all. I have noticed, also, that these questions could be divided into two classes. One which could be answered with absolute certainty—to which you could give just the information wanted by the questioner. For instance, one man writes to know how many feet of gas he will have, as ordinarily measured, if he compresses it in a cylinder of a given size to a certain pressure, say 15, 20, 40, 60 or 100 pounds. He knows that he has more gas in that cylinder than he would have in a gas holder of the same size under the ordinary gas pressure of three or four inches; but he does not know just how much. This is a question to which a definite answer can be given. It is simply a matter of someone's putting the matter in such form that it will be clear to the questioner. This question came from a man in one of the smaller towns a long way from the great centers. He had absolutely no way of getting the information, and so appealed to the Association. I think that is the proper function of our Association; and I find that quite a number of the questions are similar, inasmuch as they will admit of a definite answer. On the other hand, a good many of them are such questions as this: Is it good policy to set two gas meters, one for fuel and one for light? Now that is largely a matter of individual opinion. In questions of this sort we cannot undertake to give information which will be absolutely reliable. At the same time, even a question of that nature can be

answered to the best ability of the officers of the Association. It can be propounded at the meeting, too, and will result in discussion which should bring out a good deal of valuable information.

MR. LOWE. What suggestions have you as to the best way of reaching these men and getting this "Question Box" in motion? Is it your idea that it should be made a permanent affair? Are you going to do it through individual work, through a committee, or how? We already have an advisory board which is supposed to act somewhat in that way.

THE SECRETARY. I think it comes within the province of the advisory board, and should be attended to, possibly, by the secretary, subject to their direction. That is a matter of detail which can be easily attended to, and does not require action on the part of the Association. But I do think the matter should be brought to the attention of the Association at its meeting, and that an effort should be made to impress the members with the value of it. I think it can be made a valuable feature of our Association.

MR. LOWE. I quite agree with you.

THE SECRETARY. I will take up the first question to which I have an answer, and will continue them from time to time during our session.

Question—In a combined gas and electric light company on what basis should the executive expenses be apportioned?

MR. ALDRICH. Does that refer to the gross income from both departments?

MR. BRITTON. I take it, Mr. Chairman, that the reply means that if the income from the electric lighting service should be $10,000 and the income from the gas department should be $20,000, then the electric lighting service should bear one-third of the executive charges and the gas two-thirds.

MR. ALDRICH. What is meant by "gross income"? The receipts?

MR. BRITTON. The total earnings. This question refers entirely to the executive expenses—office expense, officers' salaries and such other items of expense as cannot be adjusted as between the accounts. The expenses of operation and maintenance can easily be divided. Taxes can also be divided very readily. But there are certain contingent expenses that cannot. It has always been a question as to what proportion each department should bear.

MR. PHILO JONES. I happen to be connected with a company that supplies water, gas and electricity. In apportioning our charges along the line suggested we have arrived at the conclusion that it cost more to operate the water department in proportion to the number of customers than it does to operate the gas and electric departments. In other words, it happens that at the present time our revenue from the gas department is the same as that from the water department, the revenue from the electric department being lower than either; however, we are charging one-half of the executive expenses to the water department.

MR. LOWE. I want to throw out a suggestion. Mr. Jones may not know it, but he is one of the very few brand new members of this Association who has ever gotten on his feet and had something to say. He may not be aware of the fact, but it is almost without precedent. Only once before I recollect that a new member got up and "spoke out in meeting." Every new member should feel that he is one of us. I am very glad indeed to hear new members get up and speak as Mr. Jones has done.

THE PRESIDENT. We hope all the new members of the Association will follow the example of Mr. Jones.

Question—On what basis would you calculate the advisability of supplying an outlying town with gas and electricity from a central plant?

MR. LOWE. Does the answer refer to gross revenue?

MR. BRITTON. I do not mind admitting that I answered that question myself. It should have been 60 per cent. per annum gross revenue on the gross cost of installation. I believe that no extension should be considered profitable in such a business as we are engaged in unless in the first two years the entire cost of the extension of the plant (so far as refers to the outside extension) should be repaid to the company. You may go into a fairly populous district and get contracts for gas, electricity or water, if you please, and the prospects may look very promising; but unless you can bind your consumers to a certain revenue of so much per month you are going to be "up in the air." A man may be a very good consumer for the first month, but conditions in his domestic economy may change, and he may be a very poor one a few months later. It does not seem to me right that any corporation such as ours should be called upon to serve a district or population with our commodity unless we can be assured of a revenue commensurate with the outlay. It is true we are quasi-public corporations, and under certain obligations to the public; but the law has recognized the fact that we are not obliged to serve under unreasonable conditions, and therefore it does not impose any condition of service that is unreasonable. It is just as well for us to calculate what our revenue is going to be as it is for any man in any other line of business to do so. It seems to me that 60 per cent. of the cost of installation is not too much to expect in twelve months. Suppose you put out $5000, a revenue of $3000 in a small amount. You must take out of that your cost of production, maintenance, depreciation, bad debts of consumers, etc., and for that reason I do not believe 60 per cent. is out of the way. I know that some members of the Association have figured it out that they should obtain at least 80 per cent., and a number of contracts have been made on that basis. It does not work any hardship to the consumer, and it does protect the company against uncertain extensions of plant. The losses of the majority of the plants in this State coming under my observation have been due to over-reaching for business in the days of severe competition with electric lighting. And the fact that many of the electric lighting companies paid no dividends was due to their giving no consideration to the proper return of revenue from the investment.

MR. ALDRICH. It always seems to be my unfortunate lot when we get together to come into conflict with Brother Britton. It seems to me that if we are blessed with cities like Oakland, where they have all the business they want, the hypothesis set forth by Mr. Britton would apply. But I am afraid that if we of the younger cities should apply his methods to our business we should be where the donkey's tail is—behind. In the younger cities we must keep up with the growth of the city. If I did not extend my mains as the districts built up I would very soon have an opposition company in the field. It may perhaps account for some of the large dividends you pay when you tell me that you must have 60 per cent. of the amount spent for mains in revenue in the first year. I expect to find Brother Britton and his directors the modern Vanderbilts of the Pacific Coast. I want to say this, gentlemen, that if I could be sure of receiving a revenue of from 10 to 15 per cent. I would very willingly pipe any district at any distance from the works. I think that, with the exception of Mr. Britton's company, or any company that does not require more business, it is a good investment when we can sit down in our offices and figure out that we are sure of 12 per cent. income on the investment. I do not think that 60 per cent. is at all reasonable. I think it is unreasonable. And, if you expect that, I think your consumers ought to come after you to make your gas 60 cents a thousand.

MR. MARTIN. It is clear that our brother from Spokane does not thoroughly understand the statement. Mr. Britton's statement and Mr. Aldrich's statement very largely agree because Mr. Britton is speaking of 60 per cent. gross revenue on the total investment as being received in one year, while Mr. Aldrich is speaking of 12 per cent. net profit. I think that your differences are not very great. One point not brought out by Mr. Britton is that just in proportion as you extend your mains your are drawing from your surplus supply of generating capacity and necessitating a larger investment later on. As a basis for calculation you will find that an income based on 60 per cent. is not too large—that is a gross income as compared with the cost of installation.

MR. ALDRICH. I would like to ask how you arrive at this 60

per cent. gross revenue. Revenue is something you never receive until your mains are laid and you are selling gas. If anyone wishes to take gas do you expect him to guarantee you a regular monthly payment, say $5?

MR. MARTIN. Yes, sir, that is it.

MR. ALDRICH. You are lucky.

MR. MARTIN. It is not difficult to meet the requirement. We have had no difficulty in meeting this requirement in guaranteed revenue in making extensions two or three miles in length.

MR. BRITTON. I am glad that Mr. Martin has acted as peace-maker between the two opponents in the association. I was about to explain that we were not very far apart. In fact, when you take 60 per cent. of the gross revenue and then figure the cost of production and distribution, wear and tear and maintenance, you get down pretty close to 15 per cent. Now there is a plan we have adopted in making extensions in large territories that works very well. Where a person applies, say at a distance of 300, 400 or 500 feet from the main, we make a calculation upon the actual cost of pipe and labor. That must be paid (and is paid without protest) by the consumer who wants the commodity. We stipulate that he shall receive a rebate of so much for each connection made upon the line of pipe until the total amount paid by him is returned. He is simply advancing the money for the gas company to do business where it is more than a reasonable extension. That, of course, does not apply to cases where the extension is less than 100 feet. As has been suggested, the law compels us to go a reasonable distance, and the Civil Code of this State has fixed that "reasonable distance" at 100 feet from the main.

MR. KEYES. I have made it a rule to lay a pipe if I can get two consumers in a block who will average $2 a month each; and I have made what I consider a very great success on that basis. It pays, if you can get two consumers in a block, to lay a main at a cost of $360 or $400.

MR. LOWE. Forty-eight dollars a year gross revenue on $400?

MR. KEYES. It is natural gas and is entire profit. There is no cost of manufacture—only wear and tear on the line. I am inclined to think the conditions are totally different.

THE SECRETARY. Notwithstanding Mr. Britton's motion that we dispense with the roll call, I would like to ask that we have one. Some time ago I was sitting at lunch with the secretary of one of the city clubs. One of the members of the club came in, and I asked the secretary who he was. "I don't know," he replied. "I thought you knew everybody in the club," I said. "No, I don't," he answered; "but everybody knows me." I find I am very much in the same position. There are a good many strange faces, and it is difficult to see who is in the hall; so I would like to ask your indulgence for about five minutes.

The following members responded to their names:

Members present—Henry E. Adams, W. A. Aldrich, William Baurhyte, A. C. Beck, W. F. Boardman, John A. Britton, C. E. Burrows, H. O. Byerly, A. Carrigan, E. F. Cheffins, O. E. Clark, John Clements, George S. Colquhoun, Frank A. Cressey, D. Decker, Walter S. Dole, D. O. Druffel, Charles W. Eichbaum, F. H. Eichbaum, Frank Foveaux, W. W. Gillespie, Charles P. Grimwood, J. B. Grimwood, A. Gutsch, Samuel Guthrie, George C. Holberton, George H. Hollidge, F. C. Jones, John S. Kaneen, George Keaton, Henry C. Keyes, George Kirk, A. J. Lloyd, George P. Low, L. P. Lowe, John Martin, A. J. P. Matthiesen, James McNeil, C. O. G. Miller, M. C. Osborn, W. E. Osborn, H. M. Papst, William M. Parker, J. E. Poingdestre, P. W. Prutzman, C. W. Quilty, Fred A. Rasch, Franklin Riffle, A. Ross, John W. Thomas, George Thompson, J. R. Thompson, Robert J. Thompson, R. P. Valentine, A. J. Vanderwhite, Hermann Weber, W. H. Wiester, G. W. Wilson.

Associate membership representatives— F. E. Fitzpatrick, J. L. Hoke, J. D. Kuster, R. T. McPherson, John Werry.

MR. HOLLIDGE. I would like to ask Mr. Britton another question. Did you say that you charged for the extension and then returned it to the consumer according to the amount that he used each month, until the whole amount was rebated?

MR. BRITTON. You misunderstand me. In extensions for a long distance we determine the cost of installation as nearly as we can. We generally figure it at less than the actual cost. Suppose a man pays us $100 to make an extension. The contract recites that for every consumer coming upon that line he shall be repaid $10; so that when ten consumers have been obtained and have become consumers of gas the $100 has been returned to him on the installment plan. No difference is made on his gas bill. It is collected every month.

[Election to Honorary Membership.]

I wish to make a motion. We have in our membership a man who today is, I believe, the Nestor of the gas business on the Pacific Coast; a man who has been associated with us ever since the formation of the organization, and who has in the past years been active in its behalf; a man who is one of our honored past presidents and who stands high in the gas world. He has given long years of service to this company (the Pacific Gas Improvement Company); and now, in the turn of Fortune's wheel, I understand that his position as gas engineer has practically been made vacant (although still retained to some extent upon the pay rolls of the corporation). In view of the services of that esteemed member in the past, and as a rightful honor to him in his declining days, I move you that the name of F. H. Eichbaum, one of our past presidents, be placed upon the honorary roll.

[Carried by unanimous rising vote.]

The meeting then adjourned until 2 p. m.

FIRST DAY—AFTERNOON SESSION.

The meeting was called to order by President Osborn at 2:20 p. m.

THE PRESIDENT. Before proceeding with the regular business of the afternoon, the Chair will appoint as a Committee for the Nomination of Officers, John A. Britton of Oakland, C. E. Burrows of Walla Walla and Henry Adams of Stockton. As a Committee on Obituaries, to present suitable resolutions in the matter of the death of C. E. Burrows, Jr., J. B. Grimwood, R. P. Valentine and J. S. Kaneen. Mr. Kaneen and Mr. Burrows, Sr., were among the pioneer gas men on the coast, and worked together in the 50's. I believe we are now ready to proceed with the regular business of the session. Our first paper will be "Practical Protection of Metal Surfaces in Gas Plants," by L. P. Lowe.

THE PRACTICAL PROTECTION OF METAL SURFACES IN GAS PLANTS.

BY L. P. LOWE

So much has been said and written on the protection and preservation of corrosive metal surfaces that a paper on this subject would seem to be almost superfluous in a gathering of engineers and practical men, but, in the course of an extensive gas engineering and construction experience, the writer has met with so many inquiries as to what is really the best coating for the practical preservation of metals in and around gas works, that he is led to believe a discussion of the subject, setting forth some of the conclusions born of rather close study on these lines may not be amiss, and while, in a general way, the conclusions reached apply to all of the engineering professions, it is the intention in this case, to consider only the preservation of the metallic structures about the gas plants, which include buildings, machinery, gas holders, tanks, street mains, service pipes, etc.

The term "coating" broadly applies to all forms of covering, such as ordinary painting, dipping, galvanizing, tinning, oxidizing, etc.; but as galvanizing, tinning and oxidizing processes are too expensive for general practical applications for gas works uses on a large scale, they may at once be eliminated in a consideration of this subject, in addition to which it is well known that they afford but an inferior protection at the best, and, when used, must themselves be protected by some form of paint.

Such coatings, such as galvanizing and tinning, are, however,

very useful and even necessary for the protection and longevity of very thin metals, such as roofing material, including corrugated iron, etc., in order to fill the pores due to the strains of manufacture in rolling such thin sheets, but notwithstanding the general impression that metal so coated is sufficiently well protected, it is quite necessary to go the additional step of painting if durability is to be insured.

Painting which includes dipping in asphaltic and like substances, is the only practical, satisfactory and economical means of accomplishing the work desired, and as "dipping" is confined to comparatively small articles, and, at the best is but a nasty, slovenly, and objectional method of applying a protective coating, it is needless to consider it where good work is absolutely necessary.

We are all more or less familiar with the many paints offered for sale, some by simple, understandable names, while others are put forth under high sounding mystifying titles, for which all manners of virtues are claimed, but how many of us ever take the trouble to investigate the genuine worth of even those whose names we can understand, to say nothing of the many others, and which, when tried, are usually purchased under a temporary mind abberation, or hypnotic spell, produced by the pleasing volubility of a salesman whose tongue runs more oil per minute than is contained in his paint per train load.

This condition would seem to indicate a sad lack of knowledge or case of neglect at the hands of a gas works manager, or engineer, but if, for a moment, we stop to consider that, in these days of rustling activity and keen competition, it is far more necessary and of greater importance to have special, rather than general skill and knowledge, it is quite evident that we must all rely upon one another to a greater or less degree, and hence it is that the dishonest and unscrupulous person can, for a time at least, impose upon his unwary and trusting brother.

If, during his experience in and around gas works, one has found a thoroughly satisfactory and durable time tried paint, or other coating, for the preservation of the metal work under his charge, then let him stick to his paragon and wave all other suggestions to the winds, but, perchance, should there be some of us who, and I think most are, still searching for the best practical metal preserver, then it is hoped the following information and suggestions may be of assistance and value.

The patented paints, and those with high sounding trade names, should, as a rule, be avoided unless they are accompanied with a formula stating their composition. Some such are doubtless excellent paints for certain specified purposes, but when such is the case there can be no valid objection to their composition being known, as paint is something which does not at once show for itself nor until much damage may have resulted from its use.

Aside from these compounds, the paints suitable for use in and around gas works may be classed under the following heads, arranged alphabetically, the names of the pigments only being given in order to identify the different kinds, asphalt, carbon, graphite, iron oxide, red lead, tar and white lead.

With the exception of asphalt and tar, the above pigments must be mixed with a vehicle, or carrier, to form a paint, and it may be stated and accepted without danger of valid contradiction, that a high grade and perfectly pure linseed oil is the only satisfactory article which can be used for this purpose if durability is to be insured, and if another equally good substance is in existence, the writer is not familiar with it.

The linseed oil may be either raw or boiled. The former dries more slowly and usually requires the addition of a drier to admit of being worked within a reasonable time limit, while the latter, or boiled oil, may be said to be self drying.

At the best, human nature is but weak, and there seems to be no reason why even honest paint manufacturers should be an exception to this rule, and they may, for our present purpose at least, be excused for decrying the merits of the products of competitors in the effort to dispose of their own, so, aside from manufacturers prejudices, it may be broadly said that all of the paints in the above list, when properly prepared and applied, are good, but some are better than others, much better, and this distinctly applies when they are used for the purpose under consideration, *i. e.*, the protection of iron and steel.

It is not the intention of the writer to enter into a scientific discussion of the relative merits of these paints, and therefore each will be only briefly considered save for that one deemed the best, and that will be treated at greater length.

Asphalt is a well-known mineral product. It forms the base of some crude oils from which it is recovered by distillation. If boiled until the volatile oils are driven off, or nearly so, the resulting product, upon cooling, is hard and brittle, and much resembles pitch. It is also found quite pure in a form resembling soft rubber, and in either state it can readily be converted into a good paint. It is prepared for application either as a cold or hot paint. If as cold paint the asphalt is dissolved in carbon bi-sulphide, or some similar solvent, which dries very rapidly, leaving the asphalt as a coating. Other ingredients are perhaps added to increase the elasticity of this paint, but at the best it is not of long life as it is very apt to crack and peel off, and accumulations of gases arising from the paint are apt to cause bubbles. It may be applied either by dipping or brushing, the latter method always being preferred by the writer.

Asphalt paint applied hot affords a more elastic and better protective coating than when applied cold, as in its preparation it is left more in its natural condition. It is, however, quite necessary that all asphalt paints should be pure and free from acids to which they are liable and which affect metal surfaces. Such pure paint is difficult to obtain, in addition to which it may be said of all paints applied hot that they are liable to the annoyances of bubbling and blistering. It is as well troublesome to properly apply a hot paint, and all asphaltic coatings, if good, lasting and well applied, are necessarily expensive, and, being very susceptible to extreme of heat and cold, they require constant watching.

The pigments of the so-called "carbon" paints are usually lamp-black (made from burning crude oil, resin or turpentine), "carbon black" (made from burning natural gas) or graphite. There is no more permanent paint pigment than carbon, but it is unfortunately so extremely light in weight as to make a paint having but little body, in addition to which it is well known that these carbon paints are all very slow driers unless mixed with a large amount of Japan, or other form of drier, which in excessive quantities is very injurious to any paint. As in the case of all other good paints, this pigment must be mixed with good linseed oil as a carrier, and, as the mixture is purely a mechanical one, the life of the paint is governed by the life of the oil. When that is gone, nothing remains but the dry powdery pigment.

What has been said of the carbon paints applies also to graphite paints.

Graphite (commonly known as black lead) is a very pure form of carbon, and is obtained by mining, or quarrying, depending upon its location. Two kinds are found, one known as amorphous graphite and the other as flake graphite. The particles of the amorphous graphite are irregular in shape, and are said to make a better and more binding paint pigment than the flake variety. Be that as it may, it still remains a fact that paints of both kinds are mere mechanical mixtures of pigment and oil, and as in the case of the carbon paints, their life is but the life of the oil.

Iron oxide is probably more generally used as a paint pigment for the preservation of metal than all other kinds combined, but its value is not in proportion to the large quantity used, but because it is well advertised, readily procurable, low in price, easily applied and pleasing in its rich brown color, it is logically popular. Being the great competitor it is soundly abused and attacked by the manufacturers of other dry pigments and mixed paints, but its record is not entirely a bad one and it has been of much use to mankind.

Iron Oxide is found almost universally and is obtained by mining. In its crude state it is usually in a hydrated condition but before it can be safely used as a paint pigment it must be thoroughly converted to the de-hydrated oxide. The carelessness of

some manufacturers in attention to this all important detail, and the ignorance of others, has caused much trouble and damage from its use, and has opened a wide inroad to the attacks of its enemies. As in the case of the other pigments decribed above, iron oxide forms only a mechanical mixture with oil, and its life, too, is necessarily limited to the life of the oil.

Tar paint is usually made from the residual tar recovered in gas works. It may be either coal tar, oil tar, or wood tar, and what gas man is not familiar with it and has his own pet recipe for its preparation (and there are doubtless many good ones), but they are all open to the same objections as asphalt paints, in addition to which tar paint is apt to contain a considerable amount of water unless expertly prepared with great care.

Let it not be forgotten that where oil is the vehicle for carrying the pigments referred to above, pure linseed oil only will give satisfactory results.

Animal oils, fish oils and mineral oils, though very largely used are thoroughly unfit for the preparation of any form of a good metal paint, and their use is largely the cause of the failure of many otherwise good paints, and their resulting condemnation.

All paint pigments, in addition to being pure, must be properly prepared and very finely ground to a powder, which, for cómmercial purposes, should pass through a mesh of 250 to the inch, but this is not all, as any honest manufacturer can insure purity, but there are other necessary qualifications, which, however, are readily procurable if materials are purchased from manufacturers of good reputation and long experience.

While the above paints may all be classed as good, there can, of course, be but one best paint for metal, and the writer firmly believes that one to be red lead.

This is an oxide of lead produced by subjecting metallic lead (pig lead) to a continuous heat in ovens or kilns, during which it gradually absorbs oxygen up to the required degree, it then being in the form of a fine, dry, red powder. It has a strong affinity for linseed oil, and when mixed with it, and allowed to set, a peculiarly hard, tenacious and elastic coating is produced, cementlike in its character, impervious to moisture and of great durability. The reason for this is that, unlike all other pigments, red lead forms a chemical combination with linseed oil, which, when dry, is a cement coating of uniform and unchanging composition and not the mere mechanical mixture as in the case of the paints previously described.

The usual conditions are thus reversed, the pigment, instead of the oil, becoming the life giving factor, and as red lead is a very stable article, a paint properly prepared therefrom and well applied, must necessarily be of long life, as it is not affected by moisture, ordinary acids or alkalies to which it is apt to be subjected, nor by galvanic action.

Lest it be forgotten, let it be again stated that the red lead must be pure and very finely subdivided, and the oil must be pure linseed only. The necessity for this will be apparent when it is undertood that linseed oil is to red lead what water is to Portland cement, *i. e.*, it serves to unite its particles. Time may dissipate the oil, but nothing except abrasion or the wear and tear of the elements, will ever remove the red lead cement.

When the combining and setting action of this paint is understood and appreciated, it will be at once apparent that it can never be procured as a ready mixed paint, as, if it remains in liquid form, even in sealed cans, it is a self convicted, fraudulent and worthless mixture, and, per contra, if impure or improperly manufactured materials are used, or adulterants added, the conversion to the cement form cannot fully take place.

While the superiority of red lead paint is now fairly well understood and admitted, there still exists some doubt and prejudice in the minds of many as to the claims made for it, but this is unquestionably because of unfortunate experience with paints supposed to be red lead, while in reality they were but spurious imitations, the writer himself having met with so many of these cases that he has come to be suspicious of the quality of both lead and oil unless purchased from reputable dealers in unbroken packages and bearing the brand of reliable manufacturers. This extreme caution cannot, of course, be observed where but a small amount of paint is needed, but, generally speaking, the writer would not think of making purchases of these materials from stores in small towns unless quite familiar with the various brands, preferring to send, for even limited quantities, to the wholesalers in the larger cities, and who may be depended upon to furnish the articles called for.

Red lead paint is scarcely more expensive than any other kind of good paint, and its covering power, while possibly somewhat less, is not so much so as to make any practical difference. These are, however, considerations which should not enter into a decision as to a coating for the preservation of iron and steel, and especially in gas works, where so much of the plant, such as street mains and service connections, are permanently placed beyond the possibility of ready inspection.

Red lead paint may be applied with equal success upon all metal surfaces used in gas works construction, including gas holders, tanks, mains, services and structural work in general. Its preparation and application is, however, of vital importance, and while the manufacturers of red lead state that it can be mixed quite as readily as other kinds of paints, the writer feels that he must disagree with them upon this point. Proper mixing need not be a dreaded bugbear, however, for the oil and pigment can be intimately and smoothly mixed by simple stirring, if necessary, but this method is a laborious one, and for this purpose it is much better to use a small revolving churn, or a regular paint grinding machine, the latter being preferred. Such machines are made in many sizes, but a small and inexpensive hand power one, costing about four or five dollars, is of ample size to quickly mix a large amount of paint, and a boy can easily do the work if provided with the materials and properly instructed.

Again bear in mind that red lead paint "sets," so see to it that the grinding machine is properly cleansed and free from paint before putting it away.

The scientific proportions for the mixing of this paint are said to be thirty-three pounds of lead to one gallon of oil, but a hard and fast rule is not necessary, it being simply requisite to introduce enough red lead to make a smooth, unstreaked coating, the quantity depending on the condition of the atmosphere, character of the work, skill of the painters, quality of the lead, etc.

It is useful to remember that seven and one-half pounds is usually considered a gallon of linseed oil, and that twenty-four pounds of red lead and five and one-half pounds of linseed oil, make about a gallon of paint, and while manufacturers state that one gallon should cover 1000 square foot of plain, clean metal surface, one coat, the experience of the writer is that a good, heavy coat, reasonable well brushed out, cannot be depended upon to cover more than about 800 square feet, but this is good work and gives a sufficiently cheap coating.

The natural color of this paint is a very bright and vivid red. It may, however, be shaded through a series of rich brown to a jet black by the mere addition of a small amount of lamp-black. One-twelfth of an ounce of dry lamp black to the pound of lead will give a seal brown, a very pleasing and durable color for gas holders and the like, and one ounce of lamp black to the pound of lead will give a jet black color to the paint. Observe caution in the use of lamp black, remembering that it is only a coloring matter, and the least amount used to produce the desired color is the best. When dry lamp black is used it should first be mixed with the oil and the red lead be subsequently added.

Either raw or boiled linseed oil can be used. The raw is thought to be generally purer while the boiled is claimed better to support the heavy particles of red lead. If raw oil is used a small amount of drier will cause more rapid setting and is said to furnish the same sustaining power for the red lead as does the boiled oil.

The use of boiled oil and lead alone is the simpler method and is preferred by the writer, but it is necessary to know that the oil has been burned over a fire and not through the bung hole of barrel. That is to say, know that the oil has been actually boiled, and not merely colored.

Red lead paint, being heavy and of great body is applied with somewhat more difficulty than other forms of paint, and must be well brushed out to a thin, firm coating else it will "sag" and "run".

Many gas managers seem to think that any one can do a sufficiently good job of painting for gas works uses, and consequently employ the services of boys and unskilled laborers in the most important work of painting expensive metal structures. This practice should, in general, be severely condemned, for, while some unskilled men may do fairly well, and all of them work conscientiously, the very secret of good work is still lacking in that the wrist muscles of boys and laborers are not developed as are those of the skilled painter who constantly uses them in the peculiar stroke called for in the application of paint by brushing.

If there is but a small amount of work to be done almost anyone can manage it with care and proper instructions, but if the work is considerable then by all means employ painters to do the painting, as you would carpenters to do your carpentering, cooks to do your cooking and doctors to treat your disease. You will certainly pay more per diem to the painter, but in return therefor you will get an increased amount of work and, what is more important, a much better job.

On metal surfaces, unlike wood, the first, or priming coat should be the heaviest. On new work at least two coats should be applied, in which case the first should be lead and oil only, while the second can be colored as described to suit the taste.

If the paint is left in its natural, vivid hue it may fade by a gradual transformation of the oxide into carbonate, but this does not impair its durability, as it is only a surface change, and slight scraping will show that red lead beneath in its original color. The changing of the color of the second coat by the addition of lamp black has an advantage other than that of mere color harmony.

When the paint, in its natural color, is applied to the dark surface of the metal, the contrast is so striking as to at once show a dark spot should the painter, by chance, fail to fully coat the metal. If the second coat is colored to a pronouncedly darker shade than the first, a reversed condition exists, and failure to fully apply the second coat is indicated by the first light color coat showing through, thus making it more than unlikely that any portion of the metal will fail to receive the proper protection.

The addition of a certain amount of white lead to red lead paint will cause it to work more smoothly and easily, but for purposes of protection only, all coats would better be red lead, and, by all means, let it be the first, or priming coat, but if to fit color schemes, as in the case of building fronts and interiors, tinted paints are necessary, then the second and after coats may be of pure white lead and linseed oil, but provide a good foundation by first coating with red lead.

The proper preparation of metal surfaces before painting is highly important, and unless carefully looked after no coating can be satisfactory as a protection against corrosion. If the metal could be cleaned to a bright surface it would afford the best resting place for the paint, but this is impracticable, expensive and unnecessary, but all rust, loose scale, grease and dirt must be thoroughly removed.

Wire brushes with short stiff teeth and scrapers made from old files will be found useful for this work. Rubbing with a piece of ordinary red or fire brick also does good work, and vibrations caused by sharp taps of a hammer will jar off much loose scale, while grease may be easily removed by washing with benzine. If deep rust marks are found from which oxidation cannot be removed by ordinary methods, common lamp oil (kerosene) may be allowed to soak in, after which the spot should be thoroughly "burned out," a convenient method being to use a painter's gasoline torch for the purpose. The kerosene is used for loosening the rust and aiding in heating same. It is burned out by the heat of the torch, which, if properly used, also roasts the rust, converting it from a hydrated to a de-hydrated oxide, rendering it harmless and easily removed, in addition to which further oxidation of the metal is checked at that spot.

All surfaces must be thoroughly dry before paint is applied, to insure proper clinging of the paint, and kept as dry as possible while it is setting. Before a second coat is applied the first must be allowed to dry to insure good work.

Red lead paint sets quickly, and metal coated one day will be ready for a second application the day following. The material should, however, be painted and allowed to rest as long as possible before use. Like Portland cement, the setting process continues for a long time and will continue even under water, although, of course, much more slowly than when exposed to the air.

The very best paint imaginable is valueless if disturbed after its application, and, as a chain is only as strong as its weakest link, so is a metal surface only protected to the extent of its poorest coating.

The writer has seen thoroughly painted pipes carefully loaded on trucks, and subsequently dragged from the tail end by a burly teamster in such a manner as to remove a narrow strip of coating along the entire length of pipe. No coating will stand this rough treatment, which can be avoided by furnishing a sufficient force to properly handle pipes without damage, but should abrasions accidentally occur they should always be touched up ere the work is left or hidden from sight, and tool marks should receive the same treatment.

Probably no structure around a gas plant should be given the best, and yet receives the poorest protection, than does the all important and vital gas holder. Its original paint soon falls from its neglected crown, sides and frame, it groans and creaks dismally and yet serenely bobs up and down by day and night through years of usefulness.

With a new holder the fault generally lies with the builder upon whom the overburdened gas man depends, and whose specifications usually read about as follows:

"All metal work will receive a shop coat of paint before shipment, and a finishing coat after erection."

That means any old thing, and that is exactly what is given. Why not specify a shop coat of red lead and linseed oil, of approved brands, properly applied in natural color by skilled painters before shipment, and a finishing coat of the same material, colored to a pleasing brown, and properly applied after erection. The great engineering professions are beginning to realize the fact that painting specifications for metal coatings cannot be too full, complete nor carefully drawn, and gas engineers must do likewise.

For the benefit of those not familiar with the method of painting gas holders in use, the writer will explain that it is his practice to, as thoroughly as possible, remove the old, loose paint, beginning with the center crown sheet, and alternately cleaning and painting each course of sheets until the crown is completed. The side sheets are best cleaned and painted by beginning at the bottom and working towards the top, course by course. At the best the bottom sheets will receive but an indifferent coating, but by taking advantage of the times when the holder is full of gas, the cleaning and painting of even these sheets can be fairly well done.

As an instance of the preserving qualities of red lead the following interesting incident came under the personal notice of the writer during his one time residence in Philadelphia. A wholesale examination of gas service connections was being made, and those which had been in the ground about twenty years were being replaced. It was an extensive piece of work and afforded ample opportunity for observation and study. The pipes were principally of wrought iron and had evidently been laid without coatings of any kind, and while some were still in a fair, and even good state of preservation after twenty years use, many were scarcely more than "a streak of rust and right of way."

One day while inspecting a very much pitted and rust eaten section of pipe which had just been removed from the trench, it was noticed that a space of several inches along one side seemed quite sound. To determine the reason the clinging earth was scraped away, when there appeared a paint having the character-

istic color of red lead, and there has never been the slightest doubt in the mind of the writer but that it was an unintentional coating given by a workman who had evidently brushed on the paint in cleaning the tool he was using in putting red lead luting on the pipe threads. The paint was hard and firm and the metal immediately beneath seemed to be excellently preserved and in as good condition as when first laid.

Ship builders have come to fully realize the value of red lead and linseed oil as a paint, and almost no other form of coating is applied to ships bottoms where the very best possible protection is imperatively demanded, and where wear and tear is probably more severe than under almost any other condition.

In conclusion a brief consideration of the chemical properties of red lead will be of interest to some, and a final word of caution may not be amiss.

Lead forms three distinct compounds of oxygen, namely lead suboxide, Pb_2O; lead oxide, PbO, and lead peroxide PbO_2. Red lead, or minium, has the composition Pb_3O_4. Lead oxide, PbO, is commercially known by the name of litharge. It is formed by the oxidation of molten lead in contact with air. When litharge is heated in the air to 900 degrees Farenheit, it takes up oxygen and is converted into minium, or red lead, Pb_3O_4, $(2PbO+PbO_2)$.

There are many substitutes on the market for red lead paint and much low grade and adultered red lead is sold. The architect or engineer, before writing his specifications, should acquaint himself with the purity and fineness of the different brands manufactured and specify by name the kind desired, as a specification calling simply for "red lead" may mean, so far as the inspector is concerned (as he has no ready means at hand of telling), a lead oxide that contains anywhere from 30 per cent. to 50 per cent. litharge (PbO), which he has to accept as red lead if it is to simply pass the blowpipe test. This may be "pure lead" but not pure red lead, as it has not been properly fired, or, in other words, has not received the highest form of oxidation, which is essential in order that it may have the proper affinity for linseed oil, which it will "take up" in its "set" after application to the metal, as explained above.

The amount of linseed oil which the red lead will take up in setting is 25 per cent. of its own weight, which gives a cement coating composed of 82 per cent. pigment and 18 per cent. oil. Oil in excess of this amount will cause the paint to streak and run on the surface of metal.

The simple formula of thirty-three pounds of red lead to one gallon of seven and a half pounds of pure linseed oil, is based on a scientific fact and must be followed in order to obtain the best possible results.

Pure red lead cannot be mixed with linseed oil and shipped any great distance, or kept any length of time, without "setting" in the package, so beware of all ready mixed red lead or red lead paste, as any substance, liquid or solid, that will hold red lead in suspension in the package, will prevent it from taking the proper "set" after being applied.

The moral is select your own materials and mix only as wanted.

Samples were then shown of the color of pure lead used alone, and also when mixed with lamp black

THE PRESIDENT. This is no doubt a paper of unusual interest to us all. I would like to call on Mr. Dole to give us some of his experiences in pipe protection in gas works in Maine.

MR. DOLE. The coating we use for service pipe is an asphalt paint. We simply dip the pipe. I do not know whether it is the best thing to do or not. Back East we used a mixture of tar and turpentine, which we found to work very well indeed. As to the lasting qualities of this asphalt paint I do not know. It seems to be all right so far, the work referred to having been done about a year ago. I cannot tell how it will be in the future.

THE PRESIDENT. I believe Mr. Beck has had considerable experience with pipe coatings. Perhaps he can give us some of his experience.

MR. BECK. We do not use very much red lead, though we have used some in construction on the salt water pipes and on some of the gas mains laid around the new works. Recently I have dug up portions of the pipe there and have found them in very good condition. The paint was perfect. This pipe had been in the ground about a year. For the services we use principally an asphalt paint.

MR. GRIMWOOD. Do you mean an asphalt paint or what we commonly speak of as "tar paint"?

MR. BECK. What is commonly called tar paint. It is a mixture of crude coal tar and oil tar.

MR. GRIMWOOD. Don't you find the use of crude coal tar inadvisable?

MR. BECK. We have had no trouble with it so far. We have been using it ever since the works were started. As soon as we began to manufacture oil gas we adopted the mixture of oil tar and coal tar.

MR. OSBORN. Do you dip your pipe or paint it?

MR. BECK. We paint it.

MR. BRITTON. Perhaps it would be fairer to Mr. Beck to explain our method of coating service pipe more in detail. The pipe is first thoroughly cleansed with a carding cloth which we get from the cotton mills. It is rubbed bright. The pipe is then put on slings and the exhaust from one of the steam pumps passed through it, one end of the pipe being left open. It is thus heated to a temperature in the neighborhood of 90 or 110 degrees. This mixture of coal tar and oil tar is then applied with a brush. When dry the pipes have a glossy appearance, as if they had been varnished. An experience of twenty years in the use of this coating demonstrates that it is perfectly impervious to the action of soils or of moisture of any sort. I can recall that at one time we took out of the ground some lengths of cast iron pipe, laid possibly a matter of fifteen or twenty years, which had been painted with read lead, and every one of these lengths of pipe was evidently just as fresh as it was the day it was put into the ground. There was no deterioration of any character whatever.

MR. ALDRICH. I agree with the president that the paper read by Brother Lowe is a very important one, and one that we shall all study carefully when we reach our homes. The preservation of our property is one of the important factors in any gas plant. But I can see, reading between the lines, that Mr. Lowe has a "baby," and that that "baby" is red lead. He has not told us anything about the cost of it. He has not told us how long we are to stand about waiting for it to dry before applying another coat on the surface. Now to my mind the question of the cost of the paint does not very much affect the case because the labor used in scraping, cleaning and painting the pipe is the important factor. I think that after your experience with oil gas on the Pacific Coast it ought not to be necessary for me to come into your midst and advocate the use of your own ingredients, because I have to send out of town for what I want to paint our holders and the iron work about our works. I want to take issue with the speaker with reference to the question of red lead as a panacea for the evils of corrosion on our iron structures; and in competition with read lead I want to place a composition which I am sure you will all recognize when I mention it. I may say here that my information was gotten five years ago in the rooms of the San Francisco Gas and Electric Company from our dear brother, Mr. Eichbaum, who has just been placed on the list of honorary members. Let the younger members take note of what they gain by becoming members of the Association and attending its meetings. I then heard Mr. Eichbaum advocate gas oil tar for the coating of iron structures. Now, with one exception, that is, in my judgment, the finest and best preservative of iron or wood, and in my experience has proved most successful. But if you will take a barrel of gas oil tar, dissolve pure rubber in turpentine (it will take several days to dissolve it), and will then mix the dissolved rubber with the gas oil tar (heating it to make a good mixture), and will then give instructions to your superintendent or foreman of works that your holders shall be thoroughly scraped (and the methods of cleaning a holder as explained in Brother

Lowe's paper I heartily agree with. It is the only way to properly clean a holder), and when the holder has been properly cleansed paint it with this composition, I venture to say, without the slightest fear of contradiction, that the holder will last for five years at least without the semblance of any necessity for repainting. I have a smokestack (and I suppose they are subjected to the most severe tests possible around gas works) sixty feet high that was painted three years ago, and that smokestack today is apparently in as good preservation as it was the first year the coating was applied. I am not taking exception at all to the red lead. Everybody knows, or ought to know, what red lead is. And I do not take exception because Mr. Lowe prefers it. But I believe you can use the ingredients about your own works, with the addition of a few dollars spent for rubber, and that you will find the expense infinitely less and the results better than if you had used red lead.

MR. FOVEAUX. I see that oil tar seems to do very well on ships. A sea captain who was very much interested in the matter applied to me several months ago for a good coating for his decks. I suggested that he try a barrel of oil tar. Since then he has gotten twenty-five barrels, paints all his iron plates with it, and believes that it gives the best results.

MR. PARKER. At San Jose we use, instead of a brush, a stick with a sack tied to it, introducing steam at one end of the pipe and leaving the other end open. We have painted over twenty miles that way in the past year, and find that it gives a very good coating.

MR. ALDRICH. How do you get under the service pipe?

MR. PARKER. We support it on a pair of horses.

MR. LOWE. It seems to be my fate to take issue with my brothers. I have not said a word against oil paint—and I am making lots of oil tar. [Laughter.] But I know red lead is better. In my paper I did mention the fact that red lead was no more expensive. You can figure it out at your leisure for yourselves. In regard to the painting of service pipe with read lead, I believe the way to do is not to wait until the service pipe is ready to be laid in the trench. Paint it before hand—six months before hand, if you want to. Oil tar paint is an excellent paint. The use of turpentine in the paint is, however, in my opinion, on a par with taking snow, putting it in milk, and imagining you have ice cream.

MR. ALDRICH. The turpentine is used simply to dissolve the rubber.

MR. LOWE. Leave both the rubber and the turpentine out and the coating will last for ten years instead of the five years you mention. I think the coating of a gas holder painted properly with red lead should stay there for fifty years. You cannot do away with wear and tear and with the effects of the elements; but you can keep your ground work solid for fifty years if properly cared for—and you can do it with no other kind of paint. All the paints are good, but there is only one best.

MR. PARKER. I saw a gas holder taken down in Napa that had been in use for twenty years. It had been receiving a coat of coal tar about once a year, and when it was taken down you could see the bright metal underneath the many coatings.

MR. HOLLIDGE. We use nothing but oil tar on our stacks, boilers and steam pipes that are exposed, on our brick work, wood work, shingles, and in fact on everything at the works, both at the power station and at the gas works. Everything is oil tar from top to bottom. We use nothing else. It preserves the surfaces beautifully. Another thing, we have some sort of microbe that gets into the mortar close to the ground. I do not know whether any of you gentlemen are subjected to them. They eat the mortar out of the bricks for about four feet above the ground. The oil tar seems to stop their work. The reason I use the oil tar on metals is not because I think it is better than red lead, but simply because it cost nothing except to put it on.

MR. LOWE. f you were buying a gas holder from a concern in the East, and were asked to specify the paint, what would you say?

MR. HOLLIDGE. I would specify read lead every time.

MR. PARKER. Would it not be better to have the holders shipped without any paint, and put your own paint on afterwards?

MR. HOLLIDGE. In all the iron vessels built in this country and in Great Britain, the first coat received on the iron is red lead. We use the tar only for cheapness.

MR. ALDRICH. Why does the outside of a vessel stink so much of tar then?

MR. HOLLIDGE. The tar is on top and the red lead underneath. Both the English Admiralty and the Navy Department in our own country use red lead. They would not use oil tar if you gave it to them.

MR. LOWE. I know it is revolutionary to come into a meeting of gas men and advocate the use of anything but tar. [Laughter.] But I have studied the question pretty thoroughly. At one time I thought it was a good plan to ship out metal work uncoated except for linseed oil to protect it from rusting, but I have changed my views, as if you put paint on top of such an oil coating you have no foundation. Bear this fact in mind, that red lead and linseed oil are the only two paint substances that unite to form a cement, just exactly as Portland cement and water do; and when you have put pure red lead and linseed oil on a structure it becomes a permanent cement.

MR. OSBORN. It seems to have been fully developed that Mr. Lowe's baby is red lead and Mr. Aldrich's rubber.

MR. GRIMWOOD. I would like to ask if any member can give figures as to the cost of painting pipe. We have heard a great deal pro and con in regard to the value of red lead and of tar. Have any of the members figures as to the cost of painting two-inch pipe, for instance, giving it a good coat of boiled oil tar or of red lead and oil?

MR. LOWE. You can figure it out for yourself. Twenty-four pounds of red lead and five and one-half pounds of linseed oil will make a gallon of paint. That will cover 400 square feet, two coats. If you spread it out thin it may do 500. I do not know just how much two-inch pipe a man can paint in a day; but he can do a great many hundred feet.

MR. WEBER. I have had a little experience in painting pipe. I had 3000 feet of one and one-quarter-inch pipe and 1000 feet of one and one-half-inch and two-inch. I bought two gallons of red lead and oil mixed, and we gave all the pipe two coats, excepting the two-inch pipe, and that has not been completed. The last time we painted a thousand feet of one and one-half-inch pipe it took two men (who were not painters) four hours and twenty minutes. We figured that it would cost about from five-eighths to three-fourth cents per foot for one and one-half inch pipe; less for one and one-quarter-inch; and probably a little more for two-inch. As to the time it takes the paint to dry, that would depend entirely on the thickness applied. If it is put on very thin a second coat can be applied the next day; but if it is done as painters ordinarily paint, it would take from three to four days before a second coat could be applied.

MR. LOWE. You could not have had pure red lead and linseed oil.

MR. WEBER. That is what it was bought for.

MR. LOWE. That is exactly the point I was trying to bring out. The paint you used is a self-convicted article.

MR. ALDRICH. As a further contribution to the question of cost I may say that two men painted one mile of six-inch pipe and four miles of black wrought iron pipe in one week—wages $2 per day.

MR. BRITTON. Our expense for painting with tar has been about one-half to six-tenths cents per foot for two-inch pipe. That includes cleaning, heating and all. I think the effect of the crude oil tar is lost by the heat in the pipe throwing off all the volatile oil, leaving practically nothing but the asphaltum. Our

pipe is always coated far in advance of our needs. It is hauled about in the service wagons after that, but seldom, if ever, shows any signs of abrasion, even where caught with a pair of tongs. The coating is as hard as enamel, and not at all brittle.

MR. LOWE. That, of course applies peculiarly to street pipe. But in gas works you go a step further. You cannot put steam in a gas holder, nor can steam be applied to construction work. Where you can apply it I know the result is a very excellent pipe coating. I simply maintain that red lead is even better than that. Of course this applies to only one condition of affairs; and you must consider all of them. My contention is that there can only be one best paint.

MR. OSBORN. Another point is the fact that all tar paints and pipe are so nearly of the same color that the men are liable to leave some part of the pipe unpainted; and it is hard to tell whether it has been neglected. As you all know, there is no part better than the poorest part. If you have red lead, or white lead, or any lead that gives a contrast of color, you are assured that when you look at a pipe you can tell whether or not it has been painted. A serious defect in the people who furnish us the structural work is their staining the first coat. The stain serves to cover up rust on the sheets. I have in mind a case where I would not allow a priming coat on a 30,000-foot holder. Seventeen of the sheets were rejected. They would have gone into the holder if there had been paint or stain on them to hide the rust. You can readily understand why some of the sheets give out while the holder is otherwise in as good condition as ever.

MR. HOLLIDGE. I would like to ask Mr. Britton if he applies his mixture on the surface hot or cold?

MR. BRITTON. It is put on cold.

MR. C. W. EICHBAUM. Oil tar used on iron work, especially on the tops of holders, never dries hard. It dries leathery, as far as I have ever seen, and never cracks. If you put on coal tar, or at least some preparations of coal tar, a slight disturbance will crack the coating. Before we used oil tar we used a mixture of Venetian red and oil on all our holders. That also never gets hard but forms a leathery coating.

MR. BRITTON. I would like to ask Mr. Beck what his experience was in painting the crowns of our large holders with oil tar.

MR. BECK. The holders were painted three years ago and the scrubber ten years ago. They are on exhibition there yet. The oil tar coating is as good as it was the day it was put on.

MR. HOLLIDGE. Did you mix rubber with it?

MR. BECK. No rubber. The scrubber stands out in the weather near the salt water, and is as much exposed as any structure could well be. There is no shelter over it whatever.

MR. BRITTON. Is it hard?

MR. BECK. Yes. It is hard. Of course it has taken on a sort of dull black color.

MR. BRITTON. Did you put it on hot or cold?

MR. BECK. It was put on cold, just as it was taken from the well.

MR. VALENTINE. I have recently had two large holders in Sacramento scraped down thoroughly so that I could see the actual condition of the metal. As nearly as I could find, they had never had a coating of red lead. The coating of tar was in some cases a quarter of an inch thick, and the sheets were in perfect condition. There is a third holder I did not dare to have scraped. The paint is all that is holding it together.

MR. LOWE. If it had had a coat of red lead originally there would have been no trouble.

MR. VALENTINE. I had occasion to move a street main a short time ago which had been in the ground about twenty-five years. It had been coated, I judged, with asphalt or coal tar, and was in perfect condition.

MR. CLEMENTS. I am inclined to agree with Mr. Lowe in the red lead proposition. If you go about in any of the great structures now going up you will find each and every piece coated with red lead. If it preserves the iron in such cases, it certainly is the best preservative for gas holders. It would be a very hard matter to convince this particular association that tar is not right, because each and every man has, at some time in his life, used tar; and in a California association particularly it would be impossible to do anything to prevent a man's sticking to tar. A Wisconsin man is called a "badger"; a Californian is a "tar-head."

MR. LOWE. Everyone who goes to Chinatown, if he is a tenderfoot, steps into a Chinese drug store and buys a prescription. You pay 25 cents for it. You get a little bear meat for strength; a little racehorse for speed; a little sand for grit. You are supposed to take the whole thing. That is exactly the kind of prescription that reminds me of a patent paint—a paint containing, for instance, turpentine and rubber. [Laughter.]

MR. GRIMWOOD. I would suggest in regard to the use of boiled linseed oil and red lead that someone try to build a gas holder of them alone. [Laughter.] I asked in regard to the cost of painting pipe (say two-inch pipe or sizes close to that) with red lead and oil, and the only replies my question elicited were in the form of statements which required sums in mental arithmetic beyond my capacity. I was trying to get results which I could compare with the results obtained in the use of boiled oil tar with a little turpentine used a dryer and thinner. I have painted quite a number of miles of pipe ranging about two-inch, and it cost me about ¼ cent per foot. I do not think you can beat that with red lead and oil. I do not think that the additional advantage in the use of red lead is sufficient to warrant the extra expense. We all have the boiled oil tar. We do not have to buy it. Only a small amount of turpentine is used as a thinning medium to make the tar flow easily. Sometimes it is a good plan to put in a very small amount of boiled linseed oil.

MR. LOWE. What for?

MR. GRIMWOOD. It has a tendency to make the paint a little less brittle. The less turpentine used the better. If you will mix boiled oil tar properly with small proportions of turpentine for a dryer and thinner, with possibly a little boiled linseed oil, I think you will get as economical and good a paint as you want for your mains and services. When you come to painting metal surfaces above ground there are other things to be considered.

MR. LOWE. I would like to ask you a hypothetical question. Suppose the oil tar paint would give you a length of life of twenty years, and the red lead paint would give you a greater length of life, say thirty years, which one would you use?

MR. ALDRICH. Suppose the reverse.

MR. LOWE. It is purely a hypothetical question. Suppose the red lead to be very much the better paint.

MR. ALDRICH. But it is not.

MR. LOWE. If the red lead paint gave much better results (irrespective of cost) than the asphalt paint, which would you use?

MR. GRIMWOOD. If the red lead gave better results, I would use it; but I am not ready to admit that.

MR. LOWE. Assume that it costs more. Take your estimate that it costs a quarter of a cent to paint two-inch pipe with oil tar, and assume that it costs half a cent to paint with red lead.

MR. GRIMWOOD. You have imposed definite conditions in the question you ask. It is simply a matter of calculating which is the cheaper. If you say red lead costs so and so much and oil costs so and so much, that labor costs a certain definite amount, and that the respective red lead and oil tar paints will last a certain number of years, then it becomes simply a matter of calculating as to which paint is advisable. But we have no definite conditions in practice.

MR. LOWE. Would not you pay twice as much for red lead as for oil tar if you were satisfied that it would very much outlast it?

MR. GRIMWOOD. I do not see how such a question can be answered.

MR. CLEMENTS. Speaking about it costing the same, you must remember that if the red lead gives your pipe longer life the real cost of the paint would be very much less. The life of your pipe is worth a great deal to you.

MR. ALDRICH. If a gallon of oil tar costs 10 cents and a gallon of red lead paint cost 20 cents, and the oil tar lasts ten years, and the red lead twenty years, the price is the same, is it not?

MR. CLEMENTS. But what about the life of your pipe? The object in putting the paint or tar upon the pipe is to lengthen its life.

MR. GRIMWOOD. The life of the pipe is the life of the paint.

MR. LOWE. If red lead is the best, use it. If it is not, discard it. It is not a question of the cost of the paint. It is a question of life.

On motion of Mr. Aldrich the thanks of the Association were extended to Mr. Lowe for his valuable paper.

A paper on "High Pressure Gas Distribution" was then read by John A. Britton.

HIGH PRESSURE GAS DISTRIBUTION.

By JOHN A. BRITTON.

WHEN asked to prepare a paper on high pressure gas distribution, I complied after very considerable urging, fully realizing, as results have proved, the utter futility of attempting to properly express in a paper that would be short enough to be interesting any considerable portion of the data requisite to make the paper understandable. It is truly a subject of vast proportions, and of such magnitude as not to be lightly treated or summarily dismissed, its ramifications into lines other than those ordinarily dealt with in low pressure gas distribution will admit of volumes being written. The question of what to eliminate from my effort has been a harder one to decide than the mere writing of it. After mature deliberation I have written on the subject entirely from the practical side, omitting all technical details or dissertations, so that the subject may be freely and fully discussed in its bearing on the every day work of the "man behind the gun."

Much has been written on the subject of flow of gases through pipes at different velocities, so that whatever I might write would be but a poor repetition, suffice it to say that the variation of density with variation of pressure, due to the elasticity of gases, makes the determination of the friction losses a most complicated matter. The variation in velocity of flow throughout the length of the lines results in a variation in frictional resistance, and the loss of pressure in a unit distance is never the same at two points in the pipe.

The economical point of horsepower required in gas compression is a large factor in determining the utility installation, and in large plants, designed for high pressure alone, this should be carefully considered.

The only science that has not kept pace with the developments of the last century, and that has not taken advantage of the suggestions of allied sciences to improve and enlarge its scope of usefulness, is the science of the manufacture and distribution of artificial gases. While the sciences of electricity, telegraphy, mechanical and civil engineering, and telephony have moved with gigantic strides over the face of the earth, the improvements in the domain of gas science have been few and far between. From the destructive distillation of coal in retorts externally heated, either by open furnaces, or by the many types of regenerative, to the process of carburetted water gas, was a far cry, and to crude oil water gas still another, while in the mechnical and other devices covering manufacture and distribution, few of any importance have been introduced in modification or improvement over those in use forty years ago; the perfection of the use of oxide of iron in place of lime for purification and the inclined retort standing out strongly in relief.

This condition of apathy may perhaps have been due to conditions of supply and demand; but the fact presents itself that until gas found a strong competitor, no especial progress was made for the improvement, either of the apparatus in manufacture, or in the means of distribution. New processes made possible by the discovery of oil in Pennsylvania, in 1875, were derided, frowned down and condemned; but finally, against the greatest of odds found their way into service, and those who came to scoff, remained to pray, and the use of carburetted water gas, under the patents of T. S. C. Lowe, has become universal.

In those good old days when Gas was King, the engineer applied his time within his laboratory in attempting to discover new phases in the composition of his gases, and worked hard and long to extract from the pound of oil, or coal, the greatest amount of salable gas, at the minimum cost of labor, but when the gas left the outlet of the holder it was like a poor orphan turned out to shift for itself, and skill and science cared for it no more, and the complaint man, with pliers and tongs, was the only friend it had; leaky mains and defective meters were tolerated so long as the price could be maintained and the manufacturing results show well on paper.

In 1884, electricity infused new life into the *dolce far niente* existence of the old-time gas man; he woke one morning from his dream of peace to find an active, strenuous little fellow in his field, whose sole ambition was to get next to the people, to show them the value of his article, and to point out its many uses; he buzzed and fumed all day, and dreamed of new schemes at night; was never satisfied with what he had done yesterday, but was determined to do a little better to-day, and what is more, he did so, then "Rip Van Winkle Gas" arose from his mighty sleep, adjusted his spectacles, rubbed his eyes, ejaculted "God bless me", unbent the rusty hinges of his gas anatomy, and went valiantly to work, found new uses for his product, awakened the interest of the public and of inventors, increased his output, gave as much, and more, attention to the sale of the product as he gave to its manufacture, and has proven himself not only a keen rival to electricity, but in many respects its master, and the two have become fast friends and are lying down together as the scriptural lion and the lamb.

To the timidity of the profession may be attributed the fact that even today high pressure gas distribution has not found favor with gas engineers, or it may be perhaps due to the old-time disease of being willing to let well enough alone, for of a certainty the advances made in that departure from old-time customs has been long enough in use to demonstrate without a doubt the entire feasibility of the plan. Natural gas has been transmitted and distributed for years over large areas of territory at pressures greater than are carried in modern types of steam boilers, and now that gas appliances may be obtained for high pressure, there is no good reason why it should not be adopted whenever and wherever the occasion requires, if the engineer will cremate his old-time hobby of leakage, and look for leakage where it generally belongs, and that is, in the generating room, and not bolster up his manufacturing results at the expense of his distributing system.

The purpose of this paper, which I promise you will be brief, will be to show how high pressure can be utilized; first, to save the laying of expensive mains; second, to bolster up low pressure in outlaying districts, and third, to transmit gas from district to district, using the high pressure mains as step down transformers.

I shall not touch upon the question of high pressure gas transmission, except as an incident leading up to the main question of distribution. High pressure gas transmission has been known for many years, and practice with never failing results, and in this connection the experience of the Oakland Gas, Light and Heat Company may not be without interest.

In 1885, it was desired to force gas from the station of the company, in Oakland, at the corner of First and Washington Streets, to a holder in the city of Alameda, a distance by shortest route of 8300 feet, across the estuary of San Antonio (a salt water creek), and discharge about 4000 cubic feet per hour into the holder, the method used for five years previously having been the exhaustion of gas at the holder from the mains laid from Oakland. The crossing of the estuary involved laying a submerged pipe two and

ne-half inches in diameter, 265 feet long, to a depth of twenty-eight feet below high water, the pipe used for the rest of the distance from the pump to the estuary, and from the estuary to the holder, being four inches. The pump used was a type of rotary made by William Foster, of Brooklyn, N. Y., similar to what had been used for pumping tar at the gas works; it had eight-inch connection and was sixteen inches by sixteen inches, making ninety revolutions per minute, and belt driven from a five-horse-power steam engine. The following excerpt from the diary of Van Leer Eastland, superintendent at that time, gives interesting details:

"The work was completed on the 28th of August, 1885, on which day the submerged pipe was lowered to the bottom of the creek on the line of Webster Street draw bridge, commencing from the northern line of draw, thence running at an angle easterly to get around pier of draw of draw bridge, thence westerly to the southern end of draw. The pipe was two and one-half inches wrought ordinary gas pipe in thickness. This was first painted with coal tar while the pipe was hot; it was then served with strips of cotton cloth that had first been saturated with coal tar, and wrapped so as to make the covering of cloth lap, and this again painted with asphaltum and coal tar; the joints were ran together with sockets over which were placed cast iron sleeves eight inches long, run with solid joint of lead, and then treated in the same manner as the pipe; when completed the compressor at ninety revolutions per minute and ten pounds initial pressure, delivered at the holder 3200 cubic feet per hour, pressure of holder two inches.

This pipe remained in service over eight years and was never renewed, excepting in cases where schooners going through the draw would drag their anchors and pull up the pipe. Such an emergency was provided for by pipe running over the draw and connected to the main line by flexible joints and having a valve at either end.

In 1893 this route was abandoned, and an eight-inch cast iron pipe laid through East Oakland across the estuary at its eastern point, a distance of over seven miles, the gas being pumped by an exhauster (or pressure blower) having a capacity of 500 cubic feet per minute at three pounds. The pipe was laid under the bottom of the creek in a concrete tube, this being made possible owing to the government engineers shutting off the water from that point during their construction of rest piers for a draw bridge.

It may be mentioned here that at no time has the candlepower of the gas delivered in Alameda been lower than the recorded candlepower in Oakland, and it has been noticeable that at no time in the past eighteen years has a complaint ever been received from the Alameda district of napthalene, nor have the drips in the twenty-seven miles of street mains in that city ever required pumping more than once in two or three years, while the drips on the main pumping line require little or no attention, except where located on the line crossing over a water way, the pipe being exposed at that point for about 1000 feet to the action of the elements.

This latter line has been operated at an initial pressure at the station of not to exceed five pounds, and at that pressure delivers 50,000 cubic feet per hour, into the holder, and at three pounds initial pressure, delivering 30,000 cubic feet per hour; the type of exhauster is that of the P. H. & F. M. Root Company's make, with a capacity of 350 cubic feet per minute, with two pounds initial pressure. Pressure at holder six pounds at outlet.

This line running through East Oakland gave rise to the first experiments of the writer with high pressure gas distribution; that section of the city, in 1897, developed a largely increased consumption. The main feeders were too small too meet the demand, and the pressure in the winter of 1896 had fallen, in the extreme portions of that district, to as low as six-tenths of a pound, plans were made to increase the size of the mains from the works, a distance of over two miles, at a cost of $12,000, to meet this demand, and to obviate this large outlay the writer conceived the idea of making the high pressure line a feeder to this district, and immediately took up the matter with S. F. Hayward, of the Connelley Company, and after quite a lengthy correspondence, and a personal visit to New York, the Connelley people undertook the building of a balance governor to fit the requirements, one that would operate at ten pounds on the inlet and distribute at four pounds on the outlet; this governor was installed in July, 1897, and has been in constant service ever since, and has never failed; operating as well with three pounds on the inlet as it does with ten pounds, which it is sometimes called upon to take care of. The result of this boost of pressure saved $11,000 and has taken care of the increased consumption in that district during the past six years, which amounts to an increase of 300 per cent., besides feeding back through the main lines to Oakland proper and taking care of a district having forty miles of mains, with a daily consumption of 200,000 cubic feet, and serving 1800 consumers; nowhere along these lines has the pressure ever fallen below three pounds. The largest main in the district is eight inches, while the majority would not exceed four inches. The exhauster is run only during the time of peak loads, say for three hours each night (except when filling holder in Alameda), and the initial pressure at that time is rarely over two pounds. Connections to the governor are eight-inch and the governor is located at or near the center of the greatest demand in the district supplied.

There is another high pressure station upon this line, situated in the city of Alameda, operating under conditions similar to the one in East Oakland; this boosts the pressure in the eastern part of that city, the district being too far away from the holder to receive the benefits of its working pressure on account of small mains. There is also another station from this line in the eastern-most portion of Oakland city, where a tap of one-inch pipe, connected from the pumping line, gives volume and pressure sufficient to fully supply consumers three miles away on a four-inch line, the consumers numbering 120; size of pipes into which gas is forced being four inches.

The foregoing is merely descriptive of a condition where a transmission line is made effective for building up a low pressure district during hours of greatest consumption.

Direct high pressure distribution presents difficulties which do not appertain to the system just described, but none that cannot easily be overcome; but it is justfied only where low pressure is not obtainable along the lines heretofore set forth. For direct high pressure straight line compressors, either direct or belt driven, may be used, and a pressure employed necessary for the size and length of mains to be laid; where pressure of under fifteen pounds is employed a preferable installation would be a positive blower, on account of minimum expenditure of horse-power per thousand. The direct high pressure system can be operated at from one pound to 100, but extreme care should be used in the laying of pipe; wrought iron should be used where pressure above ten pounds is employed and individual governors placed upon each service. The Oakland company has a line of direct high pressure in operation, being a main line running from Oakland to Berkeley, a distance of seven miles, along which line are consumers. An initial pressure at peak conditions of two and one-half pounds diminishes three miles from the station to nine inches; the services on the first three miles are served by individual governors, for the last four miles tin meters without governors are used. This line is all cast iron, and from three inches to six inches in diameter; pumping is required all day and until nine p. m. at varying pressure, from fifteen pounds water pressure to two pounds, depending upon load, the holder pressure of six pounds at Oakland serving for the balance of the twenty-four hours. The end of the line is connected into the low pressure system of Berkeley, which is tied into the low pressure system of Oakland. The high pressure and low pressure at Berkeley consists of thirty miles of mains and serves 3000 consumers with a daily consumption of about 200,000 cubic feet. No difficulty has been experienced in this service, either as to quailty or quantity of gas supplied, and the same observations made concerning freedom from stoppage on the first line applies with equal force to this one.

The inlet and outlet pipes to and from the exhauster or compressor should be large enough in area to contain enough gas to prevent a vacuum in the inlet, pressure being always desirable, and that as near as possible to the pressure of the holder from which the gas is drawn; and the area of the outlet should be large enough to prevent the pulsations which will follow from confining the gas under pressure in a small space near the compressor. These can be easily provided for, our custom having been where eight-inch connections were made to the exhauster, to have the inlet and outlet of twenty-inch pipe for a distance commensurate with the supply and demand. There should be no dead ends to a high pressure line for obvious reasons. Compression tanks should be used for the purpose of a steadiness of supply and as a reserve. These may be filled at extremes of pressure, and the service to the mains graduated in pressure as the demands require by suitable governors. Recording charts are indispensable at different points along the line for determining the pressure, and may be used with an electrical connection to the motor driving the exhauster for the governing of speed to meet conditions.

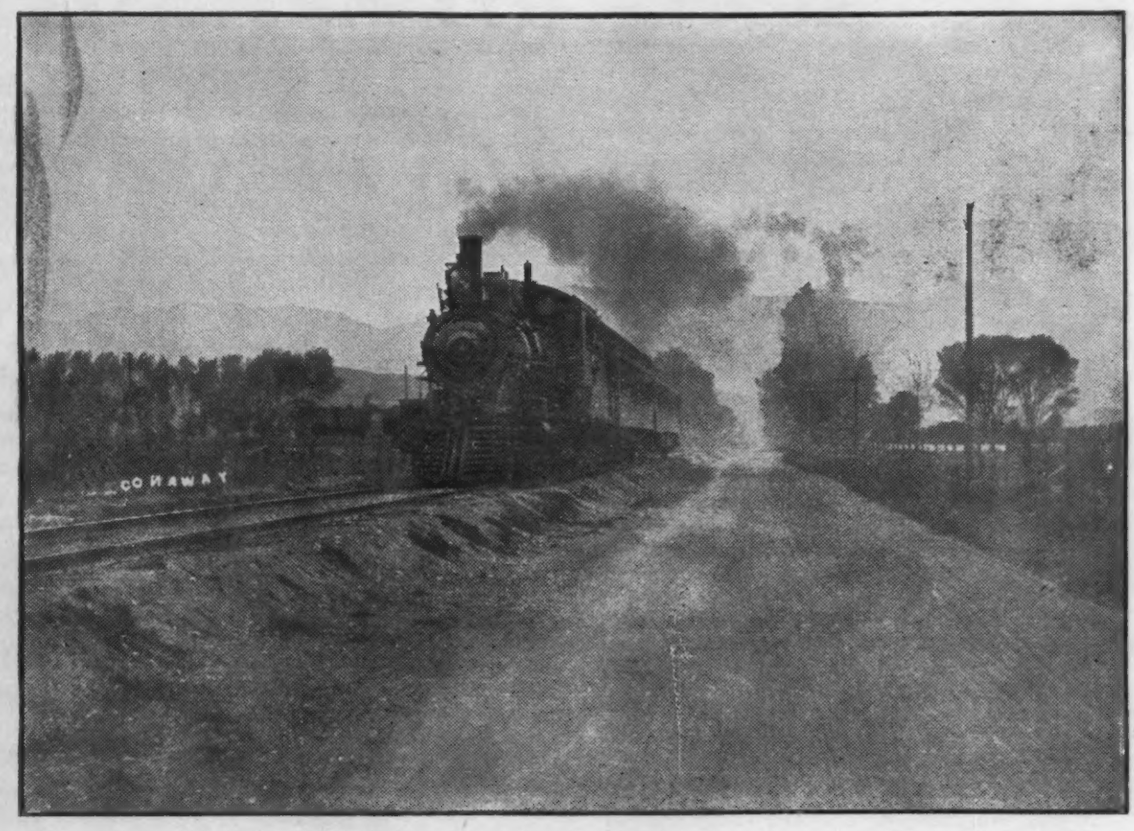
(To be concluded in the next issue.)

ANNOUNCEMENT.

THE Chair of Physics and Electrical Engineering at the Thomas S. Clarkson Memorial School of Technology has been filled by the Board of Trustees by the appointment of Byron Briggs Bracket, A. B. and A. M., Syracuse University; "Certificate in Electrical Engineering" and Ph. D., Johns Hopkins University. He is an associate member of the American Institute of Electrical Engineers and member of the American Association for the Advancement of Science.

His teaching experience has been in Dickinson Seminary, Williamsport, Pa.; Adelphi Academy, Brooklyn, N. Y.; Eastern High School, Washington, D. C.; Electrical Engineering Laboratory, Johns Hopkins University, Baltimore, Md.; Union College, Schenectady, N. Y.; Rutgers College, New Brunswick, N. J., with which institution he was last connected previous to appointment to the Clarkson School of Technology.

His practical electrical engineering experience comprises the inspection and testing of all the cable manufactured for the United States Army, during the Spanish-American war, by the General Electric Company, of Schenectady, N. Y., a year's work with the late Professor Henry A. Rowland, of the Chair of Physics of Johns Hopkins University, in the development of the Rowland Printing Telegraph, with considerable experience in commercial electrical testing at various times.



THE LOWE SPECIAL

The Santa Fe's remarkable run with the special train carrying millionaire H. P. Lowe of the Engineering Company of America, from Chicago to Los Angeles, established a new transcontinental record. The train left the Santa Fe station in Chicago at 10:15 a. m. Wednesday and arrived in Los Angeles at 1:06 p. m. Friday, August 7th, covering the 2265 miles at an average rate of 42.8 miles per hour and beating the time of the Santa Fe's California Limited by more than fifteen hours. The fastest previous run to the coast was made by the Peacock Special from West to East, its average speed being 41.7 miles an hour between Los Angeles and Chicago.

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EDITORIAL.

DEVELOPMENT OF THE GAS ENGINE.

Nothing more encouraging to gas engineers can be cited than the development of the gas engine in recent years. From statistics issued by the journal of the Franklin Institute, it appears that many makers are now building machines of 2500 horsepower, and express themselves as ready to double this efficiency. The development of large gas engines is closely connected with the evolution of the fuel gas processes, and a noteworthy fact is that the first gas engines in England above 400 horsepower were operated with producer gas, while many of the large engines in Europe have been built for use with blast furnace gas.

In August of last year, two English firms had under construction over fifty gas engines, varying in size from 200 to 1000 horsepower. A classified list of engines, made or making, shows 327 such, with an aggregate horsepower of 182,000, or an average of 560 horsepower per machine.

The last census of the United States reports 18,500 combustion engines in the country, with a total capacity of 165,000 horsepower, or an average of only eight horsepower per machine. That this state of affairs is not likely to last long is shown by the fact that one American concern has already sold over 40,000 horsepower of large engines, most of them in excess of 200 and several of them over 1000 horsepower. Another has recently built two 4000 horsepower gas compressors and a number of 1000 horsepower gas engines. The gas engines of this large size are now being extensively used for generating electric light and power, and there is a decided tendency to employ the smaller sizes direct as motors. A time is coming when cheap fuel processes will displace the electric motor for very many purposes, and the development along these lines is looked forward to very hopefully in the near future.

AN ARCTIC POWER PLANT.

A number of prominent operators in Nome, Alaska, are developing and proposing to supply the Seward Peninsula with electricity and water power for hydraulic mining on a mammoth scale. The proposition is to harness the mountain streams of the Sawtooth Mountains, east of Port Clarence, and to develop approximately 100,000 horsepower, using the water power for generating electricity, which will be carried by wire to Nome, Council City, Colofvin Bay and all other mining districts of the Seward Peninsula.

The current will also be utilized for lifting the water from the various rivers and creeks for use in hydraulic mining. The enormous cost of the present steam plants for machinery and fuel has been the means of turning the attention of capitalists to the supplying of electric power. Two engineering parties are now in the field surveying the falls and rivers of the Sawtooth Mountains, and they report that an ample volume of water, with a head of from 700 to 1800 feet, exists sufficient to develop the enormous power above mentioned.

As only three months of summer can be depended upon for a flow of water, the rest of the year everything being frozen almost solid, it looks as if this experiment would be an expensive undertaking for those promoting it. The cost of building the power line from Port Clarence, which is 100 miles north of Nome, and to extend it further to the southern points of the Seward Peninsula, would probably cost four times more than any power line built in the United States.

At no time in the northern district in Alaska does the frost recede from the surface more than three feet, which in the soft tundra of the summer season would scarcely give holding ground to the poles. Below this point the ground is frozen so hard that dynamite would be necessary to blast it out, or much time would have to be wasted to allow it to thaw sufficiently to get deep enough for proper support.

The enormous capital required to build and properly equip a line of this sort is staggering to contemplate, but if once placed in operation the owners of it should have a revenue along side of which the returns from the famous Anvil Mine would be as a peanut stand to a wholesale shipping house. The experiment will be watched with keen interest by all of those interested in power development, not only on this coast, but all over the world.

OUR NEXT ANNUAL NUMBER.

It will be remembered that last year THE JOURNAL published in the month of January what we called an annual number, and we expect to repeat the success of that issue in next January's edition. The same high grade of work in the editorial, reading and advertising columns which were the features of the last annual will characterize the forthcoming number.

The contents will be devoted to descriptions of the prominent urban and interurban electric railways of the

Pacific Coast, illustrated with fine half-tone engravings.

This preliminary announcement is made so as to give ample time to our subscribers to order extra copies in advance, and also to let our present advertisers and others desiring to avail themselves of this extra number ample time in which to prepare their copy. This issue will go to press on the 10th of December, and will be ready for delivery about the 26th of that month. The compliments showered on last year's effort were extremely gratifying, showing as they did how thoroughly appreciated were the efforts put forth. We hope this year to meet with the same ready support and favorable consideration accorded us in our last annual.

COMMUNICATIONS.

[That readers of THE JOURNAL may have a perfectly clear idea of the contention between Mr. Henry and Mr. Doble, the letter of the former, which appeared in last month's issue, and to which Mr. Doble replies, is herewith reproduced.—THE EDITOR.]

SAN FRANCISCO, September 12, 1903.

To the Editor of The Journal of Electricity, Power and Gas:

SIR—Our attention has been called to one of your recent issues in which appears a note on the subject of the Mill Creek station of the Redlands plant of The Edison Electric Company, near Los Angeles, Cal. The impression that might be produced on a reader of this note is that the Pelton wheel there referred to as in competition with another wheel was lacking in efficiency.

I feel sure that you would not wish your readers to be misled in regard to this point, and therefore take pleasure in stating that the Pelton wheel at the above station showed in efficiency measurements, made by independent engineers, an efficiency of 86.2 per cent. whereas the efficiency of the other type of wheel was materially below this amount. The tests on the latter wheel were conducted by Mr. Samuel Storrer, of the Douglas Building, Los Angeles, and Professor Hoskins. The tests on the Pelton wheel were by Professor LeConte, of the University of California.

I am authorized by The Edison Electric Company to state that such orders for water wheels as they gave for other than Pelton wheels were placed before competitive measurements of any kind were made on the wheels, and before the plant was put in service operation. We trust that you will do ourselves and your readers the justice to publish these statements so that there may be no misconception in regard to the results obtained by Pelton wheels.

GEO. J. HENRY, JR.
Chief Engineer, Pelton Water Wheel Company.

SAN FRANCISCO, September 23, 1903.

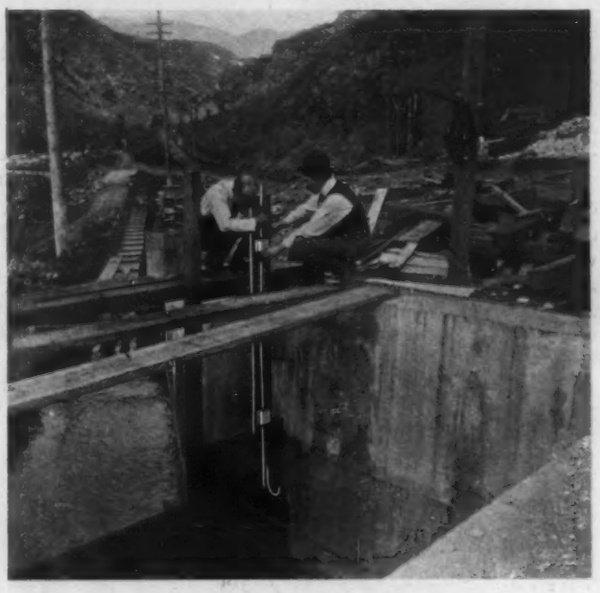
To the Editor of The Journal of Electricity, Power and Gas:

In your last issue there appeared a communication from Mr. George J. Henry, Jr., chief engineer of the Pelton Water Wheel Company, in which are some assertions which might tend to mislead your readers to the detriment of the Abner Doble Company. Accordingly, we ask leave to use your valuable columns to correct Mr. Henry's statements. While he does not in so many words say so, it is apparent that every reader must infer from his communication that there was a comparative test between Pelton and Doble wheels at The Edison Electric Company's Mill Creek plant which showed the former to be the more efficient. There was no such test.

In a letter addressed by the writer to The Edison Electric Company, the Abner Doble Company proposed that a committee of engineers, to consist of Mr. W. R. Eckart, Professor F. G. Hesse of the University of California, and Professor A. W. Smith of Stanford University, should make such a test, that the two manufacturers should share equally in the expense, and that the power company should furnish the instruments, measuring weir and other facilities therefor, and that the engineers should report in writing as to the results. This was communicated to the Pelton company, but the latter could not be induced to participate in the test.

In a letter addressed to The Edison Electric Company, dated March 14, 1902, the Pelton company said it was so thoroughly satisfied as not to be justified in going to any expense in testing the comparative efficiencies of the Pelton and Doble wheels. When a copy of this communication was sent to our company, we addressed the Pelton company directly, calling attention to the fact that The Edison Electric Company had purchased the calibrated instruments and other testing apparatus for the purpose of conducting the proposed demonstration, and we stated that if, as they expressed it, their objection to entering the test was based on the ground that they ought not to incur the expense of proving the superiority of their wheel, of which they were already convinced, we would agree that the maker of the wheel reported by the engineers to attain the highest efficiency should be exempted from all expense, the other party to pay the whole of it. We closed by offering to submit to any condition within reason which might be proposed by the Pelton company, provided it would participate in this comparative test.

In a letter addressed to us by the Pelton Water Wheel Company, dated March 25th, they declined the proposition and stated that



the wheel they were building contained some features for which they disclaimed responsibility. The result is that no comparative test was made.

Mr. Henry, however, went to the plant with Professor Le Conte, and, in the presence of the writer, proceeded to make what they treated as a test. They had omitted to provide a hook gauge to measure the water. They were forced to improvise one. Accordingly they constructed what the chief engineer of the power company called a "*shark hook*." The hook is made of three-eighths inch round iron, is six inches across, and was pointed on an emery wheel. It is fastened on the end of a long staff, and the observer stood on the platform in the position occupied by Professor Le Conte in the accompanying photograph, *i. e.*, six feet above the surface of the water. In getting the base line on this measuring staff from the edge of the weir (for this independent test) Mr. Henry of the Pelton company sighted the level. The rod was simply a redwood stick with a pencil mark on it, transferred from she edge of the weir to the point of the "*shark hook*" without plumbing it. The base line on the stem of the "*shark hook*" was a knife cut, and the readings were taken off by measuring from the knife cut on the wooden pole to which the hook was attached at the lower end. Some notion of the delicacy of this operation

may be gleaned from the accompanying photograph, in which Mr. Henry and Professor Le Conte are shown in the act of manipulating this ingenious testing instrument.

The value of this test can best be appreciated when Mr. Henry pretends to announce the results down to tenths of a per cent. It was like measuring millimeters with an unmarked yard-stick.

Accompanied by Professor Hoskins of Stanford University and Messrs. Samuel Storrow and W. H. Sanders of Los Angeles, the writer visited the Edison Mill Creek station for the purpose of conducting a comparative test in response to a telegram from the Edison company. On our arrival at the plant we were informed by Mr. Ensign of The Edison Electric Company that the Pelton company refused to consent to a test being made on their wheel. We did, however, make a test and its results show that the Doble wheel attained a materially higher efficiency than the Pelton wheel. In fact, the Pelton wheel at a constant load at its point of maximum efficiency on a three hour run, attained an efficiency of approximately 80 per cent.

Every precaution was taken to secure as reliable a test as possible. The weir was checked up by both engineers, and the leveling instruments were verified, and five minute readings were taken by the engineers throughout the entire range of the test. The water measurements were taken with very accurate hook gauges with the verniers reading to a one-thousandth of a foot and two hook gagues were used. The measurements were verified by all three engineers. At its most favorable point the Pelton wheel showed a lower efficiency than the Doble wheel. At points of partial load its efficiency was much lower. Although the specifications required that both wheels should carry an overload of 20 per cent., and the generators are 750 kilowatt, the greatest load that the Pelton wheel carried was under 780 kilowatt, while the Doble wheel carried an output on the generator of 1200 kilowatt delivered to the switchboard. Even when carrying this great overload, the Doble wheel exceeded the efficiency of the Pelton wheel at its most favorable point. This test we regarded as merely preliminary, because the indicating wattmeters were not dead beat, and their accuracy was not known. Therefore we have not published the exact results. This will be done when a final test is made before the close of the year.

As to Mr. Henry's statement that The Edison Electric Company's orders for other wheels "were placed before competitive measurements of any kind on the wheels were made, and before the plant was put in service operation, I can only say that the tests were made on the 16th and 17th of April, 1903. The written order for the last wheel unit of this plant is under date of May 9, 1903. His statement, though also misleading, is accurate in that there have been no competitive tests properly speaking.

We will be pleased to show any of your readers who may be interested, the correspondence between the Pelton Water Wheel Company, The Edison Electric Company and ourselves regarding the proposed competitive test, also the "*shark hook*." Professor Hoskins and Messrs. Storrow and Sanders will substantiate these statements in regard to the scope and manner of the test.

A further point of interest in this "*shark hook*" contest, giving 86.2 per cent. efficiency, is the fact that during the test on the Doble wheel very careful observations were made to guard against leakage around or under the weir, which you will appreciate is a most important detail to consider, as a leakage at either of these points would materially increase the apparent efficiency.

The first thing done by Mr. Henry and Professer LeConte was to open up the bottom of the weir and let the water out of the measuring part, so that the conditions under which they conducted their tests were entirely different, and must cast discredit on their results. The photograph of the Henry-LeConte "*shark hook*" shows the water passing under this weir.

As this weir was eight feet in width, it will be appreciated that the small quantity of water going over this wide weir crest made the most accurate measurements of the height of the water of the greatest importance, as an error of a thousandth of a foot in reading this height would materially affect the percentage secured.

Very truly,

W. A. DOBLE.

PUBLICATIONS.

"ELECTRICAL INFLUENCE MACHINES," a second edition, revised and enlarged, of this invaluable book has just been issued by the D. Van Ostrand Company of 23 Murray St., New York. Price, $2.00.

The author in his preface to this work has happily summed up his reason for its appearance in the following words:

"Since the first edition of this work was published, the Influence Machine has shared in the general advance in electrotechnics. Its efficiency is still, however, very much below what is theoretically possible. Theoretically, the Influence Machine is equal in efficiency to the dynamo-electric machine, which has a practical efficiency of over 90 per cent.; but owing to leakage and faulty design the practical efficiency of the Influence Machine is only about 5 to 10 per cent. There is evidently much room for improvement, and an attempt has been made in the present edition to indicate in what direction that improvement will take place."

"Descriptions of the latest machines which have proved practically successful have been added. On the other hand, many machines which have not given results of any practical value have been omitted, except in cases where they are of considerable theoretical interest."

"The chapter on Electrometers, in the first edition, has been omitted as being unnecessary in a work of this kind, when there are so many special treaties on measuring instruments accessible. Indications have, however, been given of the kind of measuring instruments to be used in investigations on Influence Machines, and references have been given to publications in which they are fully described, or to their manufacturers."

"The short account of the electrotechnic theory will, it is hoped, prove of some value in understanding the mysteries of the electric discharge in gas, and also in understanding many of the electrical processes going on in the Influence Machine when in operation."

"ENGINEERING PRELIMINARIES FOR THE INTERURBAN ELECTRIC RAILWAY." The McGraw Publishing Company, New York.

One of the most interesting engineering works published during the year is as above titled, and its scope can be readily judged from the table of contents appended herewith.

"Introductory," "Estimated Income," "General Requirements," "Third Rail vs. Trolley," "Location," "Roadbed and Track," "Rolling Stock," "Electrical Car Equipment," "Car Shops," "Power Stations," "Transmission Line," "Distributing System," "Third Rail," "Accessories," "Estimate," "Operation," "General Conclusions."

Mr. Gonzenbach has prepared in the above a digest of preliminaries, which for graphic language, conciseness, and logical conclusions, will appeal to every engineer into whose hands it may fall. The work is remarkably well edited and contains information of a recent date, based on actual experience, that well warrants its publication.

A further notice of this work will appear in our forth-coming annual number.

"ELECTRIC AND MAGNETIC CURRENTS," by Ellis H. Crapper, published in London by Edward Arnold, in New York by Longmans, Green & Co., 93 Fifth Avenue.

This is an introductory volume of a treatise of electrical engineering, dealing with the fundamental principles of electricity and magnetism, explaining all of the essential relationships of electric and magnetic circuits met with in continuous current working. The volume contains all of the essential electrical matter relating to the continuous current circuits, devotes a special space to the practical application of electricity, and indicates how the fundamental principles may be applied to the many and varied problems encounterd in practical work.

While the treatment of the subject is in no wise set forth from a text book standpoint, the contents will be found of great value

to engineers in general, and to students in colleges desiring precise and accurate information along the lines indicated.

The appendix consisting of "useful tables and constants," "physical constants," "specific resistances," "electric light and power cables," "difference between wire guages," "logarithms and antilogarithms," "natural sines and tangents," is alone worth the price of the book. It is handsomely bound and well worthy of a place in the students' library.

"REYNOLDS CORLISS ENGINES," issued by the Allis Chalmers Company, Chicago.

Nothing more comprehensive and attractive in the way of a trade catalogue, is superior to that sent out by the Allis Chalmers Company with the above caption.

Very little has been left to the imagination in this work owing to the abundant illustrations, conveying to the eye all that the reading matter carries by way of explanation. The company is to be congratulated on imparting so much information in such a small space, and in having in their advertising department one who so thoroughly understands his business.

Under the caption of "Catalogue Number 52," The Stillwell-Bierce & Smith-Vaile Co., of Dayton, Ohio, whose local office is at 11-13 First Street, this city, have issued an unique work on the power tables of Victor turbines, comprising the "cylinder gate," "register gate," and "high pressure types." The object of the catalogue is to furnish information regarding the Victor turbine wheel, and it gives data of value to engineers regarding the efficiency of the product of this well known company.

In addition to the power of Victor turbines, it includes tables which are useful to those contemplating investment in the development of water power. The publication includes a number of power installations made by the Stillwell-Bierce & Smith-Vaile Co. It is handsomely illustrated throughout, and appropriately bound in seal covers. The booklet is unique from the fact that so much information is furnished in a brochure that can be readily carried in the vest pocket.

It may be obtained on application to any of the offices of the Stillwell-Bierce & Smith-Vaile Co.

If there is one company in the United States which takes a superlative pride in disseminating fine literature, that company is the "Crocker-Wheeler," of Ampere, New Jersey, of which the Abner Doble Company of this city are the Pacific Coast agents. The latest pamphlet issued by this company is entitled "A Crocker Wheeler Railway Generator," and is a gem in every way. It is well worthy the attention of engineers contemplating new installations or changes in old ones.

"REGISTER OF MINES AND MINERALS OF SIERRA COUNTY, CAL.," issued by the State Mining Bureau, San Francisco.

A complete and comprehensive register of mines and minerals of Sierra County, Cal., from data collected to June, 1903 has just been issued by the State Mining Bureau of California, of which Lewis E. Aubury is the mineralogist. The work is accomplished by an economic geological sectional map of Sierra County, complete in every detail.

This work may be secured on application to the State Mining Bureau, price of which is $.25 and $.08 additional for postage.

One of the most beautiful and comprehensive trade pamphlets ever published in San Francisco, has just been issued by Chas. C. Moore & Company, well-known engineers of 63 First Street, this city. In a concise way, this pamphlet sets forth the installations made by the company of steam power plants on the Pacific Coast, and embraces within its covers a description of some forty power plants, ranging from hotels and business houses to such important institutions as the Independent Light and Power Company and the United Railroads of San rancisco. The territory covered includes the Hawaiian Islands and almost every State west of the Rocky Mountains.

The pamphlet is printed on heavy plate paper, embellished with beautiful half-tones, and will form a most welcome and useful addition to the libraries of steam and electrical engineers the world over. The premises formerly occupied by Messrs. Chas. C. Moore & Company at 32 First Street, owing to the growth of the business, were found inadequate, necessitating the removal to the present larger and more commodious quarters at 63 First Street, which are regarded generally as the finest business offices occupied by any firm in San Francisco.

The pamphlet just issued under the title of "Steam Power Plants of the Pacific Coast," will be mailed upon application to those desirous of securing same.

A CORRECTION.

San Francisco, September 22, 1903.

To the Editor of The Journal of Electricity, Power and Gas:

DEAR SIR—In your last issue, I notice that probably through a stenographic error, I am misquoted as saying, "I don't know whether this is the result of our wheel and I think we have cause to be very well satisfied." What I did say was, that "I do know that this is the result with our wheel and I think we have cause to be very well satisfied." These remarks referred to the efficiency of the Pelton Water Wheel at The Edison Electric Company's Mill Creek station, from which the extremely high efficiency of 86·2 per cent. is being obtained at full generator load under 1923 feet effective head, and which I believe to be by far the highest authentic efficiency on a tangential wheel, working under anything like such severe conditions.

Shall appreciate your publication of this letter to make the technical parts of the discussion more clear to your readers.

Very truly yours,

GEORGE J. HENRY, JR.

ANOTHER POWER LINE.

JOSEPH A. ROSSI of San Francisco has located certain water rights on what is known as Hat Creek and other creeks in the vicinity, located in Shasta County, Cal., and the preliminary survey of the property indicates that about 4000 horsepower can be developed under a 1400-foot head, making the transmission of power to Redding, Anderson, Red Bluff and other towns in the vicinity easy.

Capital has already been interested in the proposition and Mr. Sydney Sproutt, the well-known engineer, who was sent north to investigate, has rendered a most favorable report on the proposition. Some development work has already been done, and the enterprise will be pushed forward as rapidly as possible.

SAN JOAQUIN POWER.

J. S. Eastwood has been making surveys for a year past and filing on power sities for H. E. Huntington. It is understood that Mr. Huntington's plans on the San Joaquin River are very large and that he contemplates tapping the main river about twenty miles north of Shaver, taking the water by an elaborate system of tunnels and pipe lines through the mountains to South Fork. There, will be constructed a great reservoir. From there the waters of South Fork and Big Creek will be picked up and taken to another reservoir. From the Big Creek reservoir which has a natural pressure, a fall is obtained of over 2000 feet. From here the water is again taken up in tunnels, conduits and pipe lines and carried a distance of four and a half miles, and here again a drop of 1700 feet is obtained. This involves the construction of three power plants. The whole flow of the river will be augmented by the conserved flood water, which will be considerably more than double, and the total will be nearly 1000 inches.

The Standard Underground Cable Company announces the removal of their San Francisco office, October 1st., from the Mills Building to more commodious quarters in the Crossley Building, at Mission and New Montgomery Streets.

INDUSTRIAL

FIGURE 1. 300 HORSEPOWER, TYPE A, S K.C. INDUCTION MOTOR, WITH OUTBOARD BEARING

THE S.K.C. SYSTEM.*

TO complete our line of high grade alternating current apparatus, we are now offering a comprehensive line of induction motors, which we recommend as being of the usual high S.K.C. standard. The induction motor by reason of its simplicity of construction and operation and its high efficiency, is becoming more and more popular, not only as an adjunct in great transmission systems where alternating currents are necessarily employed, but also for local distribution of power in factories, mines, and other industrial establishments, where in many instances it has been given the preference over the direct current motor. As the conditions of operation for alternating current motors cover a very wide range, we have not deemed it expedient to make one style answer for all service, but have developed three distinct types, which are separately treated below.

This is the simplest type of motor extant. The armature or secondary is of the "squirrel cage" type, and consists of straight copper bars laid in partly closed slots, with practically no insulation, and short circuited by means of heavy end rings as shown in Figure 3. Injury to the armature either by heating or by mechanical displacement of the parts is practically impossible, and the wear on the motor is reduced to that which takes place in the bearings.

Owing to the extreme simplicity of armature construction, the Type A motor is the most desirable where the conditions admit of its use; namely, where the motor is not required to start heavy loads, or where a large starting current will not injuriously affect the potential regulation of the system. It is possible to start the Type A motor by simply closing the line switch, and this method is used with motors below five horsepower. But as the first rush of current, when so starting, amounts to several times the running current, it is advisable to use with the larger sizes of motors a

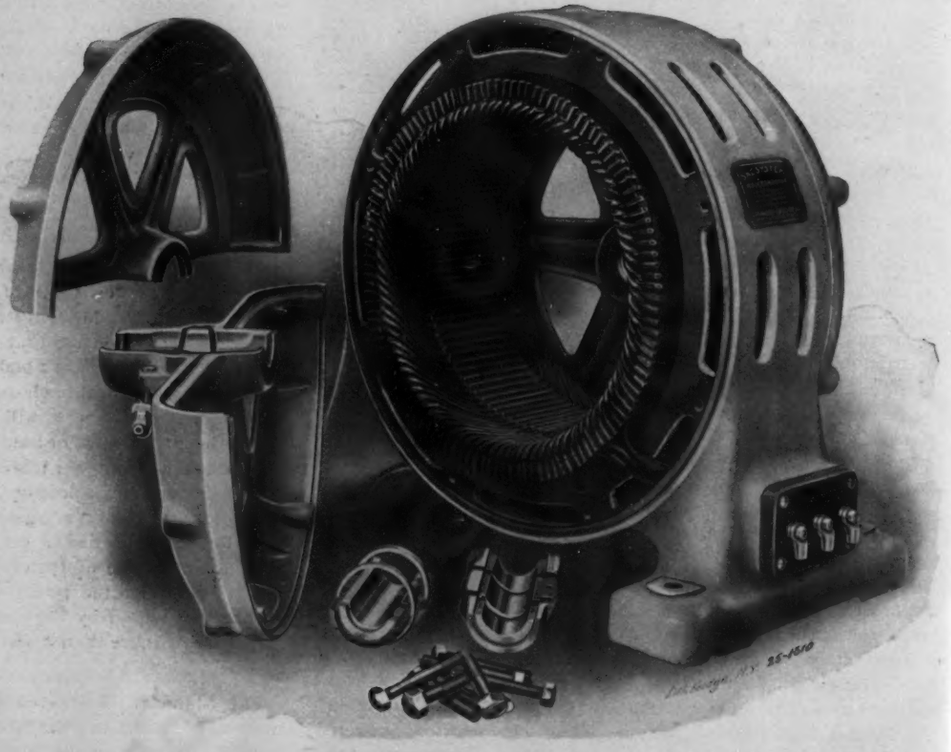


FIGURE 2. S.K.C. TYPE A INDUCTION MOTOR, WITH ARMATURE OR SECONDARY REMOVED, SHOWING FIELD OR PRIMARY WINDING AND BEARINGS IN THE END FRAMES

*Bulletin No. 136, Stanley Electric Manufacturing Company, Pittsfield, Mass., July, 1903.

INDUSTRIAL

device called a starting compensator to reduce the voltage impressed upon the motor, and thus decrease the current taken. The starting compensator consists of a single coil transformer in each phase of the circuit, with taps brought out at various points of the winding in order that a number of potentials may be obtained. The compensator is provided with a double-throw oil switch, by means of which, after starting, the coils are cut out and the full voltage of the line applied to the motor. Figure 4 shows diagrammatically the construction of the compensator and the method of connecting it to the line and to the motor.

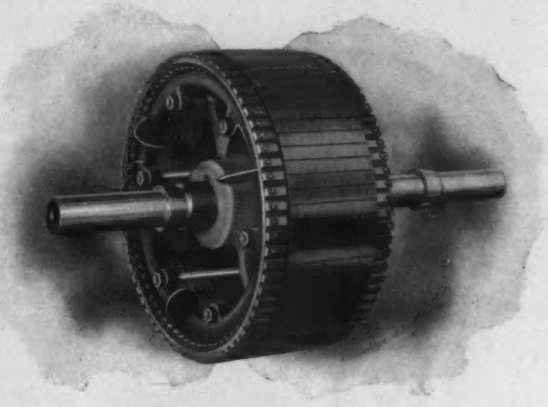


FIGURE 3. ARMATURE OF TYPE A MOTOR

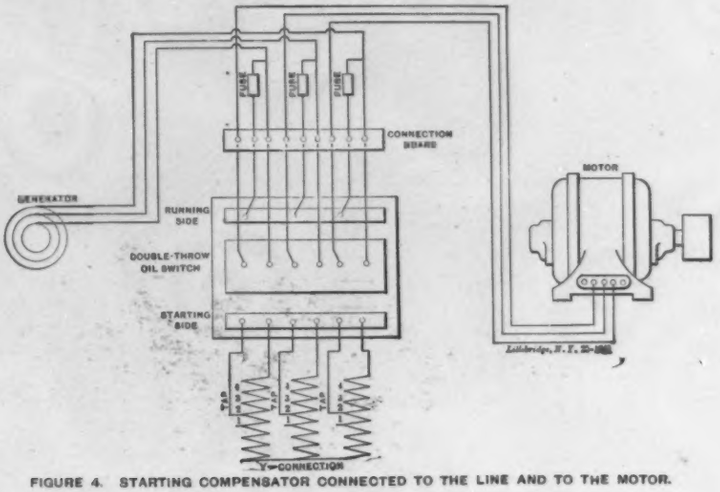


FIGURE 4. STARTING COMPENSATOR CONNECTED TO THE LINE AND TO THE MOTOR.

The point at which the compensator should be connected will depend upon the torque which the motor must develop on starting. We send out the compensators connected to the first tap in the winding, so as to give the minimum voltage, and therefore the lowest current. Should the torque thus developed be unequal to that necessary, a proper adjustment of the connections of the compensator to secure a higher potential can readily be made. Where motors are located near and operated from a bank of transformers, it is often practicable to obtain the reduced potential necessary for starting by means of taps brought out from the secondary of the transformers, thus obviating the necessity for a special starting compensator.

As has been already described, the starting current is kept low in the Type A motor by reducing the voltage applied to the primary. In the Type B, this result is secured by introducing starting resistance within the secondary circuit. The Type B motor does not possess the same simplicity of construction as the Type A, owing to the fact that the armature has a polar winding, and a device for varying the armature resistance is necessary, but it has this advantage—it will start a given load with a current materially less than that taken by the Type A. The Type B motor is so designed that for a given torque the starting current will not exceed the running current. Therefore this type is recommended where the motor must start heavily loaded, and where a large current, such as the motor with short circuited armature takes when starting at full load, would be objectionable.

The starting resistance is placed within the armature spider, and leads are brought out from several points of the resistance to a set of contacts parallel to the shaft. A lever on the outside of the motor operates a sliding collar, which is arranged to pass over the contacts, so that the resistance, on starting the motor, can be short circuited step by step. The whole device is very substantial and has no delicate parts, and, with proper care of the contacts, does not give any trouble whatsoever. Figure 5 shows a Type B motor complete, and Figure 6 a Type B armature.

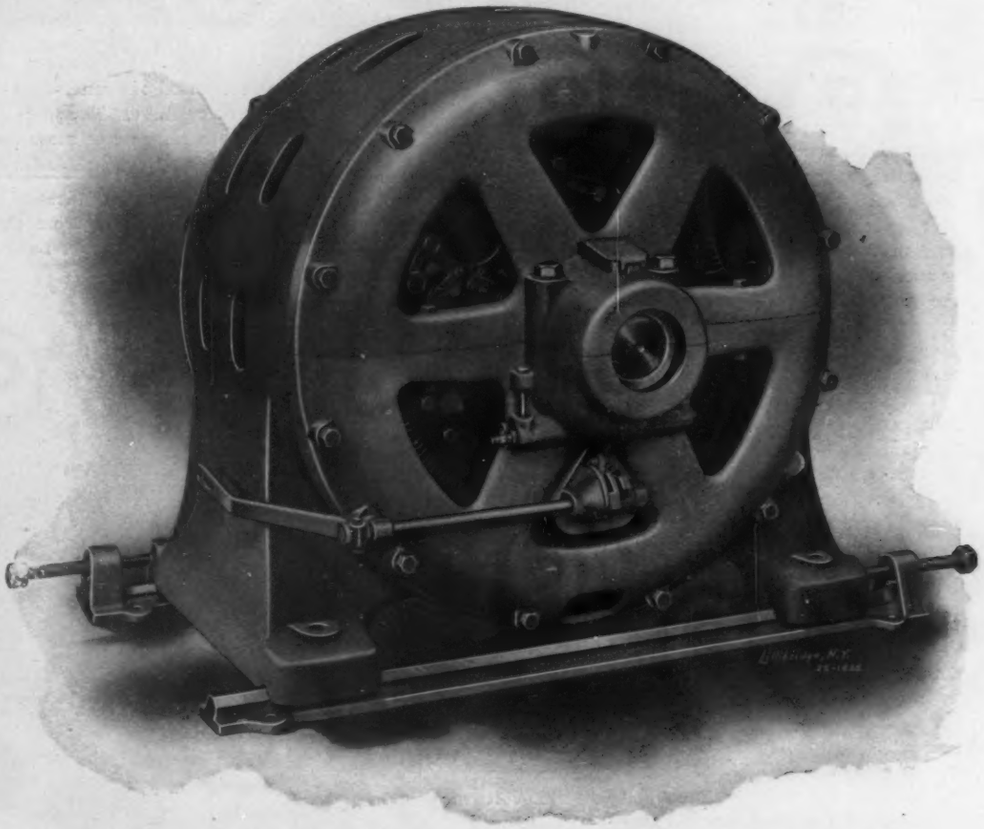


FIGURE 5. S.K.C. TYPE B INDUCTION MOTOR

INDUSTRIAL

Of the several ways in which the speed of an induction motor may be varied, by far the most practicable and that which gives the widest range of variation is rheostatic control; *i. e.*, a variable resistance within the secondary circuit located external to the armature. This system of control is based on the principle that the drop in speed of an induction

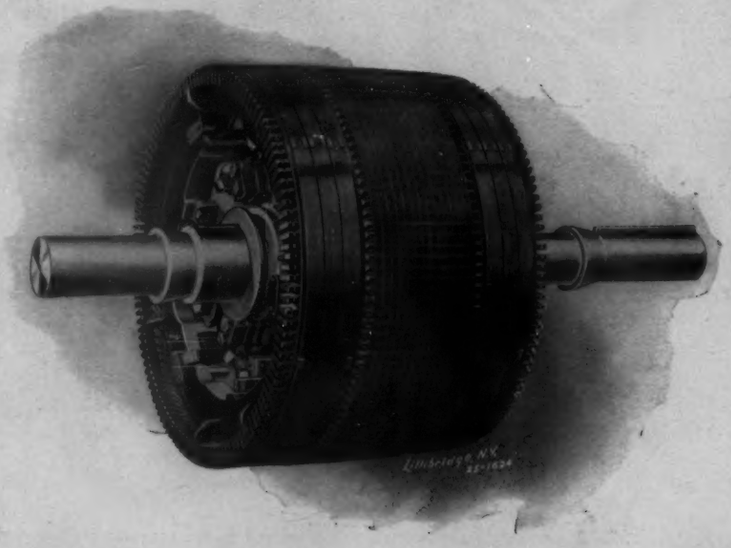


FIGURE 6. ARMATURE OF TYPE B MOTOR

motor for any given torque is proportional to the resistance of the secondary or armature circuit. The S.K.C. variable speed motor, known as the Type C, is shown in Figure 7. The armature winding is similar to that of Type B. The leads from the windings are carried through a hollow shaft to the collector rings, by means of which connection is made with a suitable controller for cutting in and out the external resistance. In this way the desired speed variation is secured. As is obvious, the controller constitutes a most satisfactory device for starting the motor.

In all induction motors, the apparent power applied to the motor (as computed by the volts multiplied by the amperes) exceeds the real power, owing to the fact that the current lags in phase behind the electromotive force. The "idle" current, however, exercises its full heating effect upon the system and allowance must be made for it in determining the capacity of the generators and transformers. It is therefore highly essential that the power factor, *i. e.*, the ratio between the real and the apparent watts, should approximate unity. Our motors are unusually satisfactory in this respect, and the efficiency is also remarkably high.

The S.K.C. motors can develop a torque of at least 200 per cent. of their normal full load. Therefore, they are not liable to injury by temporary heavy overloads. The temperature rise of a motor of either of the three types on a continuous run at full load will not exceed 40 degrees centigrade. The speed of the Type A and Type B motors varies but slightly from no load to full load, the variation not exceeding 2 per cent. in the larger motors, and 5 or 6 per cent. in the smaller sizes.

Our induction motors operate equally well in any position, provided, of course, that the shaft remains horizontal. They may be suspended from the ceiling or from the sidewall. The standard S.K.C. induction motors are wound for frequencies of 25, 40 and 60 periods per second. The standard potentials for the 25 cycle motors are 220 volts for capacities under 50 horsepower, and 440 volts for capacities of 50 horsepower and above. The 60 cycle motors are designed for the same potentials, and in addition the regular line includes 2080-volt motors in capacities of 50 horsepower and above. The 40 cycle motors of all sizes are designed to operate at 550 volts.

Motors of these standard potentials should be specified in all cases where new installations are being designed, or the motors are to be supplied with their own transformers. When necessary we can supply motors to run on other voltages, but not with the same promptness nor with such a liberal guarantee as to efficiency, etc., as we can for the voltages specified.

SOME RECENT INSTALLATIONS.

THE Electric Storage Battery Company, of Philadelphia, has recently closed contracts for the installation of batteries of the "Chloride Accumulator" for the Indianapolis and Northern Railway, at Sulphur Springs, Ind., making seven batteries operated by this Company, and an increase in the battery already installed for this Company at Broad Ripple, Ind., an increase in the two batteries recently installed for the Los Angeles Railway, Los Angeles, Cal., and an installation for the Northwestern Elevated Railway of Chicago, Ill.

Four new batteries have been contracted for by the Chicago Edison Company, making thirteen batteries operated by this Company; an installation for the Paterson Edison Company, Paterson, N. J., the second battery for the Los Angeles Edison Company, Los Angeles, Cal., and an additional battery for the New York Edison Company, which makes twenty-two batteries operated by this Company.

Isolated Lighting and Power Plants are being installed for the Murphy Building, and for William P. Stevenson at Detriot, Mich. Alexander Winton, Cleveland, Ohio; F. T. F. Lovejoy, Pittsburg, Pa., The House of the Good Shepherd, Roxbury, Mass., and for the Irving Building, Louisville, Ky.

William Currie of the Stanley Electric Manufacturing Company, who, for some time past, has been at the Pittsfield Works as Mr. C. C. Chesney's assistant, has been appointed sales engineer of the Chicago office of the company.

After a period of twenty-four years in the electrical business on Montgomery Street, The John M. Klein Electrical Works have removed to larger and more commodious quarters at 107 Battery Street.

The New York sales offices of the Nernst Lamp Company have recently been removed from the Equitable Building and transferred to the new Hanover Bank Building, No. 11 Pine Street.

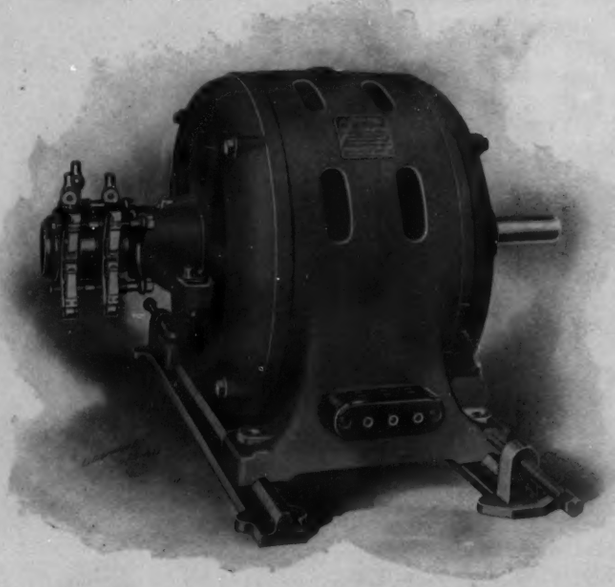


FIGURE 7. S.K.C. TYPE C (VARIABLE SPEED) INDUCTION MOTOR